INSECTICIDE CONCENTRATIONS IN THE SAN JOAQUIN RIVER WATERSHED, CALIFORNIA

Summer 1991 and 1992

by

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ABSTRACT

From 1988-1991, scientists from the Central Valley Regional Water Quality Control Board (CVRWQCB) tested water quality in the San Joaquin River (SJR) watershed using bioassays. Results indicated water samples from certain regions of the watershed caused mortality to the water flea, *Ceriodaphnia dubia*, and the authors indicated insecticides were the potential cause. Prior to the CVRWQCB tests, little work had been conducted to characterize insecticide concentrations and distributions in this watershed. Therefore, to obtain more information a survey was conducted from 1991-93, focusing on three seasons of high insecticide use: (1) winter dormant spray, (2) spring, and (3) summer seasons. This report summarizes the summer season while additional reports cover the winter and spring seasons. The survey consisted of weekly or twice weekly sampling at three sites in the main stem of the San Joaquin River to establish temporal patterns of water quality parameters and insecticide concentrations. In addition, spatially distributed sampling was conducted in the watershed at 18 sites on two occasions in the summer of 1992. Water samples were analyzed for basic water quality parameters as well as organophosphates, carbamates, and endosulfan (I, II, and sulfate). Eleven of 35 analytes were detected during the summer season. The most frequently detected chemicals were methomyl (80 of 112 samples, 71%), dimethoate (67 of 112 samples, 60%), endosulfan sulfate (32 of 112 samples, 29%), and diazinon (8 of 58 samples, 14%). The remaining seven analytes; aldicarb sulfoxide, azinphos-methyl, carbaryl, chlorpyrifos, endosulfan (II), methidathion, and methiocarb, were detected in less than 4% of the samples.

Total pesticide use, distribution of use, and physical-chemical characteristics were useful, but not definitive, for determining the potential for insecticide runoff in the watershed. To establish an efficient, effective program to reduce pesticides in surface water, a two part approach might be helpful. The first involves edge-of-field measurement of runoff losses under conditions likely to promote a decrease in mass loading to surface water. The second involves the investigation of surface water models for their potential to (1) help prioritize pesticides for monitoring by predicting their runoff potential and (2) make predictions about insecticide load reductions necessary to meet water quality goals.

Over the course of the two year study during all three seasons, diazinon exceeded the California Department of Fish and Game (CDFG) recommended acute criterion of 0.08 µg/L at 14 of 18 sites. Endosulfan exceeded the U.S. EPA acute criterion of 0.22 µg/L at one location. The other insecticides measured in this study did not exceed either the U.S. EPA acute criteria or the CDFG recommended acute criteria. However, other researchers found chlorpyrifos to exceed the U.S. EPA acute criterion of 0.083 µg/L in this watershed. Therefore, monitoring for chlorpyrifos, diazinon, and endosulfan should continue in order to measure progress towards reducing concentrations of these insecticides in the SJR watershed.

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INTRODUCTION

The SJR flows through the northern portion of the San Joaquin Valley, an area of intensive agriculture. In counties with perennial SJR flow (Merced, San Joaquin and Stanislaus Counties), major crop acreage includes alfalfa, almonds, beans, corn (silage), grapes, tomatoes, walnuts, and wheat. Over 300 pesticides were used in these three counties, with an annual reported usage of over 18 million lbs in 1992 (DPR, 1993).

In spite of the high use of pesticides in this region, little work had been conducted to characterize their distribution in surface water prior to this study. The temporal distribution of pesticides had been monitored monthly by the U.S. Geological Survey (USGS) at one site on the SJR since 1988 (Anderson et al., 1990; MacCoy et al., 1995). This site is currently part of the USGS National Stream Quality Accounting Network. Pesticide concentrations were also measured once in 1985 at 32 additional sites in the basin (Shelton and Miller, 1988). Pesticides detected in water in these surveys include carbofuran, carbaryl, chlorpyrifos, DDT, diazinon, dieldrin, ethion, lindane, and ethyl and methyl parathion. More intensive spatial and temporal sampling, and pesticide mass-loading in the SJR watershed, had not been conducted at the time this study began.

In 1988, scientists from the Central Valley Regional Water Quality Control Board (CVRWQCB) began testing water quality in the San Joaquin River (SJR) watershed using bioassays. The purpose of those tests was to characterize water quality in the SJR, its tributaries and drains, and to identify sources of toxicity seen in bioassays (Connor, 1988). Results indicated waters from certain regions of the watershed caused mortality to the water flea, *Ceriodaphnia dubia* (Foe and Connor, 1991). The specific cause of toxicity was not determined but was attributed to pesticides in general.

Due to the reported toxicity of SJR water to *C. dubia* and the need for more information concerning spatial and temporal patterns of pesticide residues in the river, a two-year study was conducted from 1991-93. Analytical screens used for this study focused on insecticides since *C. dubia* is an aquatic invertebrate. Sampling was conducted in three seasons of high insecticide use: (i) the winter dormant spray season (December - February), (ii) the spring season (March - April), and (iii) the summer season (July - September) when a large variety of crops are grown. The objective of these studies is to document the spatial and temporal distribution of insecticides in the watershed during peak use seasons. This report contains data collected during two summer seasons: July, August, and September of 1991and 1992. Two additional reports cover the remaining seasons (Ross et al., 1996; Ross et al., 1999).

MATERIALS AND METHODS

Study Area Hydrology

The San Joaquin Valley, approximately 12,000 mi^2, can be divided into two drainage basins, the San Joaquin and Tulare Basins (Fig. 1). The Tulare Basin is a closed basin: water drainage begins and ends within the basin boundaries. In addition, surface water streams are all ephemeral (Domagalski, 1995). In contrast, the San Joaquin Basin drains into the Sacramento-San Joaquin Bay Estuary, a valuable fishing and wildlife resource. The basin contains surface water streams and rivers, both ephemeral and perennial in nature. The SJR itself has perennial flow from Stevinson (site 1 in Table 1 and Fig. 1), northward about 40 river miles to Vernalis (site 17), passing through Merced and Stanislaus Counties. Downstream of Vernalis, in San Joaquin County, tidal influence from the estuary begins. Sampling in this study was restricted to areas of perennial flow in the San Joaquin Basin due to its potential year-round contribution of pesticides to the estuary.

The SJR has three major tributaries on the east side of the valley: the Merced, Tuolumne, and Stanislaus Rivers, which originate in the Sierra Nevada Mountains (Fig. 1). In addition, there are a number of small irrigation district drains which carry excess irrigation water as well as agricultural runoff water from the valley floor to the San Joaquin River and these tributaries. Soils on the east side of the valley, which originate from the Sierra Nevada batholith, are generally coarse textured and well drained (Domagalski, 1995). On the west side of the valley, surface water streams are ephemeral and originate in the Coastal Range. These tributaries frequently carry rain and irrigation runoff from agricultural fields. Soils on the west side, which originate from the marine shales of the Coastal Range, are generally fine textured and highly erodible (Domagalski, 1995).

Sampling Plan

During July, August, and September of 1991 and 1992, sampling was conducted once or twice weekly at three sites, (7a, 10, and 12), in the San Joaquin River (Fig. 1). Site 7a was located just upstream of the confluence with the Merced River, site 10 was located at Patterson, and site 12 was located at Laird Park (Table 1 and Fig. 1). Weekly sampling was conducted from July 2 through September 13, 1991, and July 8 through September 9, 1992. These sites served as indicators of the temporal variation in water quality parameters and insecticide concentrations occurring in the study area. In addition, two spatial surveys were conducted at 18 sites in the watershed, one at the end of July (July 27-31, 1992), the other at the end of August (August 24-28, 1992). The spatial survey gives more information about the distribution of insecticide residues in the watershed during the summer season. Lagrangian surveys (conducted in the winter and spring seasons (Ross et al., 1996; Ross et al., 1999) were not attempted during the summer months due to low water velocities and water ponding in the study area.

Water samples were collected with a USGS D77 or DH77 water sampler using the equal-width increment, depth-integration method (Guy and Norman, 1970), taking 10 to 30 vertical sections across the stream width. Grab samples were also collected when stream width was too narrow and depth too shallow to use either the D77 or DH77 sampler. All water collected at a site was composited in a stainless steel container then split with a ten-port Teflon splitter (USGS designed) into 1-liter glass jars. Split samples were analyzed for total suspended sediment (TSS), total organic carbon (TOC), organophosphate insecticides (OPs), carbamate insecticides (CBs), and endosulfan (Tables 2 and 3).

Water Quality Measurements

Water quality parameters measured *in situ* include water temperature, pH, dissolved oxygen (DO), electrical conductivity (EC), and ammonia. Stream discharge was also measured at sites without gaging stations. Water pH was measured with a Cole Parmer ATC pH wand (model 05830-00). Dissolved oxygen was measured with a YSI (Yellow Springs Instruments) dissolved oxygen meter (model 57). Electrical conductivity was measured with a YSI salinity-conductivity-temperature (SCT) meter (model 33). Ammonia was estimated in the field using an ammonia-nitrogen test kit made by CHEMets (model AN-10). Discharge at each site was calculated by measuring stream velocities (using the six-tenths-depth and two-point methods) then summing these velocities across the stream width (Buchanan and Somers, 1969). Velocities were measured using a Price AA current meter (Buchanan and Somers, 1969).

Total suspended sediment and TOC were also measured. To measure TSS, 100 to 200 mL of sample were passed through a pre-cleaned 0.7 µm filter in accordance with USGS procedures (Fishman and Friedman, 1989). The method detection limit is 0.3 mg per sample. To measure TOC, a Dohrmann DC-85A TOC analyzer was used in accordance with instrument instructions (Dohrmann, Santa Clara, CA). The method detection limit for this procedure is 4 mg/L.

Pesticide Analysis

Water samples were screened for organophosphate (OP) and carbamate (CB) insecticides (Tables 2 and 3), and endosulfan (I, II, and sulfate forms). When the study began in the summer of 1991, the OP screen was not completely developed, i.e. additional insecticides were still being tested for inclusion in the screen. In 1991, the OP screen consisted of ten parent insecticides and eight breakdown products whereas in 1992, the OP screen consisted of 14 parent and nine breakdown products, including diazinon and the diazinon oxygen analog (Tables 2 and 3). The CB screen consisted of six parent and three degradation products in both 1991 and 1992. To preserve chemical constituents in the OP and CB screens, samples were acidified with 3N HCl to a pH of 3.0. In most cases, these insecticides were adequately preserved at pH 3.0 for at least 2 weeks in storage at 4°C (Ross et al., 1996). However, diazinon broke down rapidly at this pH and therefore was analyzed with the endosulfan sample, which was not pH adjusted.   All pesticide analyses were performed by the California Department of Food and Agriculture's Chemical Analytical Laboratory.

Organophosphate Screen

Water samples (1L) were extracted with 100 mL methylene chloride by shaking for 2 min. The methylene chloride layer was drained through 20 g sodium sulfate and transferred to a 500 mL round bottom flask. The sample was extracted two more times, dried, and added to the round bottom flask. The solvent was evaporated to dryness using a rotary evaporator at 35°C and transferred with one 5-mL rinse, and two 2-mL rinses with acetone, to a calibrated tube. The extract was reduced to 0.5 mL under N_2 without heat, and brought to a final volume of 1 mL with acetone. Analysis was performed by gas chromatography (GC) using a Varian Model 6000 (Varian, Palo Alto, CA) or a Hewlett Packard GC model HP-5890 (Wilmington, DE), equipped with a flame photometric detector and a Hewlett Packard, HP-1 methyl silicone-gum column (10 m by 0.53 mm by 2.65 µm). Initial oven temperature was 150°C, held for one min, and increased to 200°C by 10°C/min, and held for two min. This temperature was then increased to a final temperature of 250°C by 20°C/min and held for five min. Injector and detector temperatures were 220°C and 250°C, respectively. Method detection limits are listed in Tables 2 and 3.   Method validation recoveries can be found in Ross et al. (1996).

Carbamate Screen

Water samples (100 g) were extracted using three 100-mL aliquots of methylene chloride, shaking vigorously for one min. Solvent layers from all three extractions were poured into a 500 mL round bottom flask and concentrated to 3-5 mL on a rotary evaporator at 30-35°C. About one g of sodium sulfate was used to remove any water from the concentrate and then filtered through a 0.45 µm filter into a calibrated tube. The flask was rinsed with two 2-mL aliquots of methylene chloride and filtered through the same filter into the same tube. The extract was reduced to dryness under N_2 at 35°C, brought to a final volume of 0.2 mL with methanol, and mixed for about 15 sec using a vortex. Immediately prior to high performance liquid chromatography analysis, 0.9 mL of water were added and the sample mixed for about 15 sec using a vortex, and transferred to an autosampler vial. Analysis was performed using a Hewlett Packard 1090 Liquid Chromatograph equipped with a C18 column (4.6 mm by 25 cm by 5µm), a Pickering Labs post-column derivatization system (Pickering Labs, Mountain View, CA) and a Hitachi F1000 fluorescence spectrometer set at 340 and 450 nm excitation and emission wavelengths, respectively. A water-acetonitrile gradient was used to separate the analytes. Method detection limits are listed in Tables 2 and 3; method validation recoveries can be found in Ross et al. (1996).

Diazinon and Endosulfan Screens

Water samples (about 1 L) were extracted twice with 100 mL and once with 80 mL aliquots of methylene chloride, shaking for 1.5 min, venting often. Solvent layers were drained through 30 g sodium sulfate into a 500 mL flat-bottomed boiling flask. The sodium sulfate was rinsed with three 10-mL aliquots of methylene chloride and added to the flask. The extract was evaporated just to dryness on a rotary evaporator at 40°C and transferred to a calibrated tube using 8 to10 mL of acetone and brought to a final volume of 2 mL under N_2 at 40°C.

For diazinon, analysis was performed by GC using a HP 5890 equipped with a flame photometric detector and a HP-1, methyl silicone gum column (10 m by 0.53 mm by 2.65 µm). Initial oven temperature was 150°C, held for two min, and increased to a final temperature of 200°C (held for one min) by 10°C/min. Injector and detector temperatures were 220°C and 250°C, respectively. Method detection limits are listed in Tables 2 and 3; method validation recoveries can be found in Ross et al. (1996).

For endosulfan, a florisil clean-up procedure was used, when necessary, prior to analysis. The extract solvent was exchanged from acetone to hexane under N_2 at 35°C. Extract was poured into a column filled with 10 cm heat-activated florisil, topped with 12 mm sodium sulfate and pre-wet with 50 mL hexane. The extract was loaded quantitatively to the column and eluted with 200 mL of a 50% diethyl ether:hexane (containing 10-25 g anhydrous sodium sulfate) and collected in a 500 mL flat-bottomed boiling flask. The eluant was reduced to 2 mL on a rotary evaporator at 40°C, transferred to a calibrated tube using 8 to 10 mL hexane, and brought to final volume of 2 mL under N_2 at 40°C. Analysis was performed by GC (Varian Model 6000) equipped with an electron capture detector and a HP-1 capillary column, 25 m by 0.2 mm by 0.33 µm. Initial oven temperature was 150°C, held for two min, and increased to 250°C by 25°C/min, and held for six min. Injector and detector temperatures were 230°C and 300°C, respectively. Method detection limits are listed in Tables 2 and 3; method validation recoveries can be found in Ross et al. (1996).

Quality Control

As part of a quality control (QC) program, data generated during method validation (see Ross et al., 1996) were used to assess all subsequent study results. Specifically, method validation data were used to establish warning and control limits similar to that described by Miller and Miller (1988). A warning limit is the mean ± 2s, where the mean is the average % recovery found in method validation and s is the standard deviation. A control limit is the mean ± 3s. Continuing QC samples consisted of laboratory water spiked with an analyte at a given concentration that is extracted and analyzed with each extraction set (Appendix I). An extraction set consists of one to 13 field samples, and depends on how many samples are received in the laboratory for processing at any one time. During the course of the study, continuing QC samples are compared back to the warning and control limits. If a continuing QC sample exceeds the warning limit, the chemist is notified. If the continuing QC sample exceeds the control limit, corrective measures are taken in the lab to bring conditions back under control. Only field samples potentially low in concentration, as indicated by QC results that are below the lower control limit, are noted in the report. In addition, blind spikes were analyzed (Appendix II). A blind spike is a surface water sample that is spiked by one chemist and submitted to another for analysis. The analyte and concentration of blind spikes is therefore not known by the chemist performing the analysis.

As an additional quality assurance measure, a total of ten field-rinse samples were prepared during the two summer surveys. All sampling equipment was cleaned in the field using four distilled-water rinses after sample collection. Field-rinse samples were prepared by pouring distilled water into all sampling equipment after a typical cleaning procedure. These samples were then collected in one-liter amber glass jars, as was done for all water samples. Field-rinse samples were transported and stored with other water samples, and analyzed for all insecticides as well as TSS and TOC. Field-rinse samples served as a check on potential sample contamination during collection, transport, and storage. Neither TSS, TOC, nor insecticides were detected in these samples (Appendices III and IV).

Water Quality Objectives and Criteria

Water quality measurements and insecticide concentrations will be compared with acute objectives and criteria designed to protect freshwater aquatic life (Table 5). Objectives established by the CVRWQCB (1994) will be used as the primary comparison. If the CVRWQCB has not established an objective for this watershed, the most recent U.S. EPA freshwater criterion (1986 and 1987) will be used. If the U.S. EPA has not established a criterion, the water quality criterion suggested by the California Department of Fish and Game (CDFG) will be used. The criteria established by these agencies were selected for comparison because they follow established U.S. EPA methodology for criteria development (Stephan et al., 1985).

In addition, comparisons will be made only with acute objectives and criteria since samples collected in this study were short-term in nature (i.e. samples took anywhere from a few minutes to one hour to collect). Comparison with chronic values is not appropriate under these circumstances since chronic criteria are applied to longer time periods. For example, U.S. EPA chronic criteria require averaging over a four-day period. Measurements in this study reflect a maximum of two hours, during any given 96-hour (4-day) period. Large variation in concentrations exist even when measurements are made once a day. For example, on the SJR at Vernalis, a four day average concentration of diazinon for samples collected once daily, can have a coefficient of variation of 70% during rain events (see MacCoy et al., 1995, sampling dates Feb. 10-13, 1994), and 74% during dry periods (see MacCoy et al., 1995, sampling dates Feb. 15-18, 1994). Due to the large variation even in once daily sampling, comparisons with chronic criteria were not made.

Finally, acute criteria are site specific, *i.e.*, criteria are not to be exceeded more than once every three years, on average, at a given location (Stephan et al., 1985). Therefore, comparisons with acute criteria will be made on a site by site basis using the data available.

RESULTS

Quality Control

For the OP screen, 540 continuing QC spikes were made during the two summer seasons (Appendix I and Table 4). Of these, one (0.2%) was above the upper control limit and nine (1.7%) fell below the lower control limits. Of 276 CB spikes, six (2.2%) were above and one (0.4%) below the control limits (Table 4). Of 136 endosulfan screen spikes, zero were above and one (0.7%) below the control limits (Table 4). Field samples analyzed with continuing QC values below the lower control limit are noted in the data tables.

There were 23 blind-spike analytes prepared and analyzed during the summer seasons (Appendix II). Two spikes (both for azinphos-methyl) exceeded the upper control limit and one spike (diazinon) was just below the lower control limit. Fonofos was most frequently below the lower control limit and should be re-evaluated for continued inclusion in the OP screen.

Water Quality Measurements

<u>Temporal Variation</u>

Water quality measurements were made at three sites in the San Joaquin River once or twice weekly in July, August, and September of 1991 and 1992 (Fig. 2, Appendix III). Water temperatures at the time of sampling ranged from 18 to 29°C and pH ranged from 7.6 to 8.9. Six of the pH values were above the maximum water quality objective (pH of 8.5) established by the CVRWQCB (CVRWQCB, 1994; Table 5). Water pH exceeded the objective three times at site 7a and three times at site 10 and occurred in both years. The pH at site 12 remained within the 6.5 - 8.5 objective.

In addition to temperature and pH: DO and EC were measured (Fig. 2, Appendix III). Dissolved oxygen ranged from 5.6 to 18 mg/L, with none below the CVRWQCB objective of 5.0 mg/L for this warm water habitat (see CVRWQCB, 1994, for habitat designations). Electrical conductivity ranged from 1150 to 2650 µS/cm. These EC values are similar to those reported before in the SJR (Shelton and Miller, 1988; Anderson et al., 1990). Water quality objectives and criteria have not yet been established for this parameter in this portion of the watershed. However, all EC values exceeded 700 µS/cm, a water quality goal suggested for agricultural areas (Marshack, 1998).

Additional environmental measurements include ammonia, discharge, TSS, and TOC (Fig.3, Appendix III). Total ammonia ranged from 0.3 to 2 mg/L. Criteria for ammonia concentrations are dependent on water temperature and pH and did not exceed the criteria recommended by the U.S. EPA (U.S. EPA, 1986). Discharge ranged from 65 to 500 cfs in the San Joaquin River, lower than in other years when rainfall was closer to average. (Water year 1991 marked the sixth year of a drought in California.) Total suspended sediment ranged from 26 to 600 mg/L and numerical objectives for this parameter have not been established. These values are similar to those reported in the San Joaquin River in other seasons (Ross et al., 1996; Ross et al., 1999). Total organic carbon ranged from <4 to 19 mg/L and fell within the range of concentrations measured previously in the SJR (Shelton and Miller, 1988; Anderson et al., 1990; Ross et al., 1996; Ross et al., 1999). Numerical objectives for this parameter have not been established.

<u>18-Site Surveys</u>

Water temperatures varied with location and date of survey, and ranged from 20 to 32°C (Fig. 4, Appendix IV). The pH ranged from 7.1 to 8.8, and on four occasions, exceeded the 8.5 maximum objective established by the CVRWQCB (CVRWQCB, 1994; Table 5). These occurred at four SJR sites: Stevinson (site 1), Hills Ferry (site 7), Laird Park, and Vernalis (site 17). The reason why the objective was exceeded is not clear from the data collected.

Dissolved oxygen ranged from 3.3 to >12 mg/L (Fig. 4), values indicating deoxygenated and super-saturated conditions, respectively. Two measurements were below the CVRWQCB objective established 5.0 mg/L for warm water habitats (Table 5). These occurred in the Newman Wasteway (site 5), a site previously found to have low DO (Ross et al., 1996; Ross et al., 1999), and the SJR near Stevinson. The Newman Wasteway is a cement lined ditch built to move operational spill water from the Delta Mendota Canal and to drain nearby agricultural land. Water in this conveyance is frequently slow moving or stagnant, which may contribute to low DO values.

Electrical conductivity ranged from 103 µS/cm in the Stanislaus River (site 16) to 4310 µS/cm at Mud Slough (site 3; Fig. 4). The Merced, Tuolumne, and Stanislaus Rivers (sites 6, 13, and 16) were all below 700 µS/cm, a suggested agricultural water quality goal (Marshack, 1998). Overall, the highest EC values were reported in the SJR at Stevinson and Mud Slough (Fig. 2 and 4). These sites are located in or near Kesterson National Wildlife Refuge, an area with soils that have a high selenium and salt content, contributing to high EC values found in surface water there (CVRWQCB, 1988).

Total ammonia ranged from 0.1 to 3 mg/L (Fig. 4), with the highest concentrations found in Turlock Irrigation District drain #5 (site 9). In addition to being downstream of a waste water treatment plant, this site is located adjacent to a rendering plant, which in the past was a source of ammonia. There are also a number of dairies that discharge into TID #5, another potential source of ammonia in this drain. During summer months, the U.S. EPA criteria for ammonia were not exceeded in the 18-site surveys (Table 5). This site typically had the highest ammonia concentrations found during the two year study (Ross et al., 1996; Ross et al., 1999).

Total suspended sediment ranged from 9 to 940 mg/L (Fig. 4). The lowest TSS concentrations were found in the major east-side tributaries: Merced, Tuolumne, and Stanislaus Rivers, (sites 6, 13, and 16, respectively), where soils are coarse-grained and have a low potential for erosion. The highest TSS concentrations occurred in Orestimba and Ingram/Hospital Creeks (sites 8 and 14, respectively), located on the west side of the SJR, an area of fine-textured soils prone to erosion. These results are similar to those found in other seasons in this watershed (Ross et al., 1996; Ross et al., 1999). Total organic carbon concentrations ranged from <4 to 16 mg/L (Fig.

4), low relative to concentrations measured during other seasons in this watershed (Ross et al., 1996; Ross et al., 1999).

Insecticide Concentrations

Organophosphates

Five organophosphates: azinphos-methyl, chlorpyrifos, diazinon, dimethoate, and methidathion, were detected during the 1991 and 1992 summer seasons in the SJR watershed (Tables 6 and 7). Azinphos-methyl was detected in four of 112 samples (3.6%) at concentrations ranging from 0.08 and 0.18 µg/L. The highest azinphos-methyl concentrations are generally found in summer months (Panshin et al., 1998; Ross et al., 1996; Ross et al., 1999) when use is highest. Criteria for the protection of aquatic life have not been established for this insecticide.

Chlorpyrifos was detected in one of 112 samples (0.9%) at 0.35 µg/L. This detection occurred in the SJR at Laird Park and is the highest concentration of chlorpyrifos detected in the watershed during the two year study (Table 6). A split sample was analyzed and a concentration of 0.33 µg/L was reported. As a single result, this value exceeds the acute criterion of 0.083 µg/L established for the protection of freshwater aquatic life (U.S. EPA, 1987). Chlorpyrifos was not detected above 0.083 µg/L in additional samples collected at this site or other sites during the two year survey. However, samples collected by the USGS from the Merced River and Orestimba Creek exceeded this criterion in 1993 (Panshin et al., 1998). In addition, two other samples exceeded 0.083 µg/L, one in the Newman Wasteway in the winter of 1992 and one in TID # 5 during the spring of 1991 (Ross et al., 1996; Ross et al., 1999). These data indicate waters of tributary sites may exceed the acute criterion more frequently than main-stem SJR sites. Additional monitoring for chlorpyrifos should be conducted in this watershed, particularly in tributaries where higher concentrations tend to occur.

Diazinon was detected in eight of 58 samples analyzed in 1992 (14%), and concentrations ranged from 0.07 to 0.32 µg/L (Tables 6 and 7). A draft criterion for the protection of aquatic life to acute exposures has been proposed by U.S. EPA for diazinon of 0.09 µg/L (Table 5). The CDFG has suggested that "... freshwater aquatic organisms should not be affected unacceptably if the one-hour average concentration does not exceed 0.08 µg/L more than once every three years" (Menconi and Cox, 1994). In summer months, four samples were above 0.08 µg/L at four different sites. During the two year study, including winter, spring, and summer seasons, diazinon residues exceeded the suggested acute criterion at 14 of 18 sites sampled in the San Joaquin River watershed (Tables 6 and 7, Ross et al., 1996; Ross et al., 1999). Alternatives to chlorpyrifos and diazinon have been proposed (Zalom et al., 1999) as part of an effort to reduce the use and movement of winter applied insecticides to surface water. Monitoring should continue during winter months to record any changes which occur during the coming years. Diazinon residues are also detected during spring and summer months at concentrations above 0.08 µg/L. The origin of these residues and their control should be investigated.

Dimethoate was detected in 67 of 112 samples (60%), at concentrations ranging from 0.05 to 2.4 µg/L (Tables 6 and 7). Criteria for the protection of aquatic life have not been established for this insecticide.

Methidathion was detected in one of 112 samples (0.9%), at 0.11 µg/L. Criteria for the protection of aquatic life have not been established for this insecticide.

Carbamates

Three carbamate insecticides (carbaryl, methiocarb, and methomyl) and one degradation product (aldicarb sulfoxide) were detected during the summer seasons (Tables 6 and 7). Aldicarb sulfoxide was detected in one of 112 samples (0.9%) at a concentration of 0.05 µg/L at site 7a. Criteria for the protection of aquatic life have not been established for this degradation product.

Carbaryl was detected in three of 112 samples (2.7%) and concentrations ranged from 0.05 to 0.20 µg/L. Numeric objectives and criteria for the protection of aquatic life have not been established by the CVRWQCB or U.S. EPA for carbaryl. The CDFG has suggested that freshwater aquatic organisms should not be affected unacceptably if the one-hour average concentration does not exceed 2.5 µg/L more than once every three years (Siepmann and Jones, 1998). Data collected during this two year study (Ross et al., 1996; Ross et al., 1999) do not indicate that the acute criterion was exceeded at our sampling sites during 1991-1993. However, one sample collected by the USGS from the Merced River during the winter of 1993 did exceed this value. Carbaryl was not detected in weekly samples collected from the Merced River from June 1994 through March 1995 (Ganapathy et al., 1997).

Methiocarb was detected in two of 112 samples (1.8%); concentrations were 0.08 and 0.06 µg/L in the SJR at Fremont Ford and at Laird Park, respectively. Acute criteria for the protection of aquatic life have not been established for this insecticide.

Methomyl was detected in 80 of 112 samples (71%) at concentrations ranging from 0.05 to 2.0 µg/L. Numeric objectives and criteria for the protection of aquatic life have not been established by the CVRWQCB or U.S. EPA for methomyl. The CDFG has suggested that freshwater aquatic organisms should not be affected unacceptably if the one-hour average concentration does not exceed 5.5 µg/L more than once every three years (Menconi and Beckman, 1996). This criterion was not exceeded in the watershed during this study (Tables 6 and 7; Ross et al., 1996; Ross et al., 1999). Methomyl concentrations reported by the USGS in this watershed were also below this suggested criterion.

Endosulfan

The concentration for total endosulfan was calculated using the formula:

$$\text{Total Endosulfan} = \text{I} + \text{II} + (0.96217 * \text{sulfate})$$

The weighting factor for endosulfan sulfate accounts for the difference in molecular weight between the sulfate and the endosulfan I and II isomers. This concentration was then compared with the U.S. EPA acute freshwater criterion of 0.22 µg/L for total endosulfan (Table 5).

In addition, U.S. EPA has acute criteria for both endosulfan I and II individually, of 0.22 µg/L. Concentrations were compared with these criteria as well.

Endosulfan (I, II, and/or sulfate) was detected in 32 of 112 samples (29%). Endosulfan I was not detected, while endosulfan II was detected once, and endosulfan sulfate detected in 32 samples. None of the endosulfan detections were above the U.S. EPA acute freshwater criterion or 0.22 µg/L. However, over the course of this two year study, total endosulfan concentrations exceeded this criterion at one site, Ingram/Hospital (Ross et al., 1996; Ross et al., 1999).

DISCUSSION

Insecticide Detections and Use Patterns

Organophosphates

Azinphos-methyl, diazinon, and dimethoate were detected in three or more samples collected in the watershed during summer months. Azinphos-methyl was detected twice at site 7a during weekly sampling in the SJR and at site 8 (Orestimba Creek) during both 18 site surveys (Tables 6 and 7). Use of azinphos-methyl occurs throughout the San Joaquin Valley on various orchard crops. Use of azinphos-methyl is particularly concentrated in the Newman Wasteway and Orestimba Creek watersheds (Figures 5 and 6), corresponding with detections at sites 7a and Orestimba Creek. However, use is also concentrated in the Merced River watershed but azinphos-methyl was not found there nor at sites in the SJR, downstream of the Merced. In addition, azinphos-methyl had high use during summer months (179,370 pounds in 1991 and 1992 combined, Table 8), yet was not the most frequently detected insecticide. Clearly, factors other than use are important in governing pesticide detections in surface water, such as timing of use, hydro-geological factors, agronomic practices, and physical and chemical properties of the pesticide (Leonard, 1990).

Diazinon was detected at four SJR sites and in Salt Slough and Orestimba Creek (sites 2, 18, 7, 7a, 8, and 10). Diazinon use is scattered throughout the San Joaquin Valley on orchard and truck and field crops, with some concentrated use around Orestimba Creek and Salt Slough drainage areas (Fig. 7). Diazinon use in summer months is 25% of azinphos-methyl (Table 8), yet it is detected more frequently and at a greater number of sites (Tables 6 and 7). Again, factors other than total use and distribution of use are important in predicting detections in surface water.

Dimethoate was detected in both the SJR main stem, and in all west-side tributaries sampled. Dimethoate was not detected in the southern portion of the watershed, south of the Newman Wasteway nor in the large east-side tributaries. Dimethoate is used intensively along the west-side of the SJR, with almost every square mile on the valley floor reporting some dimethoate use (Figs. 8 and 9). Use in this region of the watershed is mostly on beans and other truck and field crops. In addition, there is relatively little use in the southern portion of the watershed and scattered use on the east-side of the SJR. This use pattern likely contributes to the frequency of detections in west-side tributaries and the main stem of the SJR. Use of dimethoate in the summers of 1991 and 1992 combined, totaled 100,180 pounds in the three counties.

Carbamates

Carbaryl was detected at three sites: TID #5 and in the SJR at Patterson and Laird Park. Carbaryl use was concentrated mostly on the east-side in 1991 with increased use on the west-side of the SJR in 1992 (Figs. 10 and 11). Use of carbaryl is mainly on orchard crops, corn, grapes and tomatoes and totaled 102,520 pounds in June, July, and August of 1991 and 1992 in Merced, Stanislaus, and San Joaquin counties (Table 8).

Methomyl was the most frequently and widely detected insecticide in the SJR watershed during the summer months. Methomyl was detected at 10 of 19 sites sampled, throughout most of the watershed except in the large east-side tributaries. Methomyl use totaled 83,456 pounds in June, July, and August of 1991 and 1992 in Merced, Stanislaus, and San Joaquin counties, third highest use behind azinphos-methyl and dimethoate (Table 8). Use of methomyl is mainly on truck and some field crops during summer months and is concentrated in the southern and west-side regions of the watershed (Figs. 12 and 13).

Endosulfan

Endosulfan was detected at eight sites in the watershed during summer months (Tables 6 and 7). Endosulfan use totaled only 11,414 pounds (Table 8) yet it was the third most frequently detected insecticide in surface water. Endosulfan use is mostly scattered along the east-side of the SJR (Figures 14 and 15) and is used mostly on grapes, pumpkins, tomatoes, and in greenhouses.

Physical-Chemical Properties and Frequency of Detection

In addition to total use and application location, physical and chemical properties of the insecticides may be important for describing surface water detections. For example, azinphos-methyl use totaled 179,370 pounds with a detection frequency of 3.6% while methomyl use totaled 83,456 pounds and was detected in 71% of the samples collected. Azinphos-methyl is not as soluble, has a higher soil adsorption, and shorter field-dissipation half-life than methomyl (Table 9). These factors may be important for predicting surface water transport and are used by Goss (1992) to classify the runoff potential of pesticides. Using this classification scheme those insecticides with lower use but higher runoff potential are more frequently detected than higher use compounds with lower runoff potential (Figure 16). Dimethoate appears to be one exception and perhaps this can be explained by the location and intensity of dimethoate use. Dimethoate is used intensively on the west-side where soils are highly erodible and watersheds are small (with small dilution potential, particularly during summer months), leading to the predominant detection of dimethoate in west-side tributaries. Modeling efforts which include use data, soil types, hydrology, and geological features might aid in our understanding of which pesticides are most likely to be found in surface water and why. This could facilitate a coordinated surface water monitoring program and aid in the identification of those pesticides most likely to be transported off site. In addition, watershed modeling could be used to predict pesticide load reductions, if for example, best management practices are found that reduce edge of field runoff.

CONCLUSIONS

Eleven insecticides were detected during summer months in the SJR watershed. The most frequently detected chemicals were methomyl (80 of 112 samples, 71%), dimethoate (67 of 112 samples, 60%), endosulfan sulfate (32 of 112 samples, 29%), and diazinon (8 of 58 samples, 14%). The remaining seven analytes; aldicarb sulfoxide, azinphos-methyl, carbaryl, chlorpyrifos, endosulfan (II), methidathion, and methiocarb, were detected in less than 4% of the samples. Most sampling was conducted in the main-stem of the SJR where concentrations tend to be lower than in the tributaries. Only two 18-site surveys (which included a number of tributaries) were conducted and therefore additional insecticide monitoring, particularly in SJR tributaries, will be needed to better assess concentrations during summer months.

Over the course of the two year study (including winter, spring and summer seasons), diazinon exceeded the recommended acute criterion at 14 of 18 sites. In addition, endosulfan exceeded the U.S. EPA acute criterion in Ingram/Hospital Creek. The other insecticides did not exceed either the U.S. EPA or the CDFG suggested acute criteria during the two year survey. However, data from another study conducted in this watershed indicate chlorpyrifos exceeded the acute criterion at two sites, the Merced River and Orestimba Creek. Alternatives to chlorpyrifos and diazinon for control of overwintering pests have been proposed in an effort to reduce their runoff into surface water. In addition, permit restrictions on endosulfan use, implemented in 1991, limit discharge of endosulfan into surface waters of the state. Given these efforts, monitoring for chlorpyrifos, diazinon, and endosulfan should continue in order to measure progress towards reducing their concentrations in the SJR watershed.

Total use, distribution of use, and physical-chemical characteristics were useful, but not definitive, for determining the potential for insecticide runoff in the watershed. To establish an efficient, effective program to reduce pesticides in surface water, a two part approach might be helpful. The first involves edge-of-field measurement of runoff losses under conditions likely to promote a decrease in mass loading to surface water. The second involves the investigation of surface water models for their potential to (1) help prioritize pesticides for monitoring by predicting their runoff potential and (2) make predictions about insecticide load reductions necessary to meet water quality goals.

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Site #	Site Name	Site Description, Latitude and Longitude Coordinates (deg min sec)
1	SJR near Stevinson @ Highway 165	1 mi. S. Hwy 140 & Hwy 165 intersection 371744 1205060
2	Salt Slough @ Highway 165	371452 1205104
18	SIR @ Fremont Ford	371837 1205546
3	Mud Slough	U.S.G.S. gaging station in Kesterson National Wildlife Refuge 371633 1205511
4	Los Banos Creek @ Highway 140	Intersection with Highway 140 371636 1205716
5	Newman Wasteway	Behind the city of Newman waste water treatment facility 37 19 17 120 58 52
6	Merced River @ Hatfield State Recreation Area.	372101 1205740
7a	SIR 1 mile upstream of Merced River	372103 1205808
7	SJR @ Hills Ferry Rd.	372058 1205831
8	Orestimba Creek @ River Rd.	372452 1210049
9	TID #5	Turlock Irrgiation District Drain #5 at Carpenter Rd. 372752 1210148
10	SJR @ W. Main St.	372939 121 0446
11	Del Puerto Creek	North of terminus of Loquat Ave. 373221 1210714
12	SIR @ Laird Park	373342 1210906
13	Tuolumne River @ Shiloh Rd.	373612 1210750
14	Ingram/Hospital Creek	SE. of Dairy and Pelican Rd. 373657 1211215
15	SIR @ Maze Blvd.	373827 1211340
16	Stanislaus River @ Caswell Memorial State Park	37 41 43 121 12 10
17	SJR near Vernalis @ Airport Rd.	374033 1211551

Table 1. Number, name, and location of sites used in the San Joaquin River (SIR) study.

Table 2. Method detection limits (µg/L) for pesticides and degradation products analyzed in the organophosphate, carbamate, and endosulfan screens in the 1991 summer season.

Organophosphates	mdl[a]	Carbamates	mdl	Endosulfan	mdl
Azinphos-methyl	0.10	Aldicarb	0.05	I	0.005
Azinphos-methyl OA[b]	0.50	sulfoxide	0.05	II	0.005
Chlorpyrifos	0.05	sulfone	0.05	sulfate	0.010
Chlorpyrifos OA	0.30	Carbaryl	0.05		
DDVP	0.05	Carbofuran	0.05		
Dimethoate	0.05	3-hydroxy	0.05		
Ethyl parathion	0.05	Methiocarb	0.05		
Ethyl parathion OA	0.20	Methomyl	0.05		
Malathion	0.05	Oxamyl	0.05		
Malathion OA	0.20				
Methidathion	0.10				
Methidathion OA	0.20				
Methyl parathion	0.05				
Methyl parathion OA	0.20				
Phosalone	0.20				
Phosalone OA	0.20				
Phosmet	0.10				
Phosmet OA	0.50				

a. mdl = method detection limit.
b. OA = oxygen analog.

Table 3. Method detection limits (µg/L) for pesticides and degradation products analyzed in the organophosphate, carbamate, and endosulfan screens in the 1992 summer season.

Organophosphates	mdl[a]	Carbamates	mdl	Endosulfan	mdl
Azinphos-methyl	0.05	Aldicarb	0.05	I	0.005
Azinphos-methyl OA[b]	0.05	sulfoxide	0.05	II	0.005
Chlorpyrifos	0.05	sulfone	0.05	sulfate	0.010
Chlorpyrifos OA	0.05	Carbaryl	0.05	Diazinon[c]	0.05
DDVP	0.05	Carbofuran	0.05	Diazinon OA	0.05
Dimethoate	0.05	3-Hydroxy	0.05		
Ethoprop	0.05	Methiocarb	0.05		
Ethyl parathion	0.05	Methomyl	0.05		
Ethyl parathion OA	0.05	Oxamyl	0.05		
Fonofos	0.05				
Malathion	0.05				
Malathion OA	0.05				
Methidathion	0.05				
Methidathion OA	0.05				
Methyl parathion	0.05				
Methyl parathion OA	0.05				
Phorate	0.05				
Phosalone	0.05				
Phosalone OA	0.05				
Phosmet	0.05				
Phosmet OA	0.05				

a. mdl = method detection limit.
b. OA = oxygen analog.
c. Diazinon and diazinon OA were analyzed with endosulfan. See text for explanation.

Table 4. Results of continuing quality control samples analyzed during the 1991 and 1992 summer seasons.									
	1991			1992			1991 and 1992		
Analyte	Total	High[a]	Low[b]	Total	High[a]	Low[b]	Total	High	Low
Organophosphate Screen									
Azinphos methyl	18	1	0	12	0	0	30	1	0
Azinphos methyl OA	15	0	0	4	0	0	19	0	0
Chlorpyrifos	19	0	0	12	0	0	31	0	0
Chlorpyrifos OA	18	0	0	4	0	0	22	0	0
DDVP	18	0	0	12	0	0	30	0	0
Diazinon	19	0	0	12	0	0	31	0	0
Diazinon OA	18	0	0	5	0	0	23	0	0
Dimethoate	18	0	0	12	0	0	30	0	0
Ethoprop[c]				9	0	1	9	0	1
Ethyl Parathion	18	0	0	5	0	1	23	0	1
Ethyl Parathion OA	18	0	0	4	0	0	22	0	0
Fonofos[c]				9	0	4	9	0	4
Malathion	19	0	0	12	0	0	31	0	0
Malathion OA	18	0	0	5	0	0	23	0	0
Methidathion	18	0	0	12	0	0	30	0	0
Methidathion OA	18	0	0	5	0	0	23	0	0
Methyl Parathion	18	0	0	12	0	0	30	0	0
Methyl Parathion OA	18	0	0	4	0	0	22	0	0
Phorate[c]				4	0	0	4	0	0
Phosalone	18	0	0	5	0	0	23	0	0
Phosalone OA	18	0	0	5	0	0	23	0	0
Phosmet	18	0	2	12	0	1	30	0	3
Phosmet OA	17	0	0	5	0	0	22	0	0
TOTAL	359	1	2	181	0	7	540	1	9
Carbamate Screen									
Aldicarb	17	0	0	14	0	0	31	0	0
Aldicarb sulfoxide	16	4	0	13	2	0	29	6	0
Aldicarb sulfone	17	0	0	14	0	1	31	0	1
Carbaryl	17	0	0	14	0	0	31	0	0
Carbofuran	17	0	0	14	0	0	31	0	0
Carbofuran 3-Hydroxy	16	0	0	14	0	0	30	0	0
Methiocarb	17	0	0	14	0	0	31	0	0
Methomyl	17	0	0	14	0	0	31	0	0
Oxamyl	17	0	0	14	0	0	31	0	0
TOTAL	151	4	0	125	2	1	276	6	1
Endosulfan Screen									
Diazinon[c]				15	0	0	15	0	0
Diazinon OA[c]				16	0	1	16	0	1
Endosulfan I	19	0	0	16	0	0	35	0	0
Endosulfan II	19	0	0	16	0	0	35	0	0
Endosulfan sulfate	19	0	0	16	0	0	35	0	0
TOTAL	57	0	0	79	0	1	136	0	1

a. Continuing quality control sample result was above the upper control limit (see Appendices I and II).
b. Continuing quality control sample result was below the lower control limit (see Appendices I and II).
c. Analyte not analyzed in the 199 1 summer season.

Table 5. Acute water quality objectives and criteria for the protection of freshwater aquatic life.

Constituent	CVRWQCB Objective?	US. EPA Criteria!	CDFG Suggested Criteria[c]
pH	6.5 - 8.5	6.5 - 9.0	NA[d]
Dissolved Oxygen[e]	5.0 mg/L (warm) 7.0 mg/L (cold) 7.0 mg/L (spwn)	3 .O mg/L (warm) 5.0 mg/L (warm, early life stage) 4.0 mg/L (cold) 8.0 mg/L (cold, early life stage)	NA
Electrical Conductivity	NA	NA	NA
Total Ammonia[f]	NA	0.009 - 35 mg/L	NA
Azinphos-methyl	NA	NA	NA
Chlorpyrifos	NA	0.083 µg/L	NA[g]
Diazinon	NA	0.09 µg/L (DRAFT)[h]	0.08 µg/L
Dimethoate	NA	NA	NA[i]
Methidathion	NA	NA	NA[i]
Carbaryl	NA	NA	2.5 µg/L
Methiocarb	NA	NA	NA
Methomyl	NA	NA	5.5 µg/L
Endosulfan (Total)	NA	0.22 µg/L	NA

a. Objectives are from: Central Valley Regional Water Quality Control Board. 1994. Water Quality Control Plan (Basin Plan), Central Valley Region, Sacramento and San Joaquin River Basins. Third Edition. Sacrament CA
b. Criteria are from: United States Environmental Protection Agency. 1986. Quality criteria for water 1986, and Quality criteria for water 1986, Update #2. EPA 440/5-86-001.
c. California Department of Fish and Game's suggested acute criteria; see Menconi and Cox 1994, for diazinon; Siepmann and Jones 1998, for carbaryl; Menconi and Beckman 1996, for methomyl.
d. Not available.
e. Dissolved oxygen objectives and criteria are dependent on habitat type (warm, cold, or spawning habitat).
f. Total ammonia criteria are dependent on temperature and pH and therefore have a wide range in values.
g. The suggested criterion in CDFG's chlorpyrifos hazard assessment (Menconi and Paul, 1994) was a combined fresh and salt water value. In discussions among staff from CVRWQCB, DPR, and CDFG, it was decided that CDFG would develop a separate fresh water criterion, in accordance with U.S. EPA methods.
h. Draft criterion prepared by University of Wisconsin-Superior and Great Lakes Environmental Center for the U.S. EPA. 1998. Ambient Aquatic Life Water Quality Criteria Diazinon. EPA Contract No. 68-C6-0036.
i. Due to a lack of data, CDFG could not develop criteria for dimethoate and methidathion using accepted U.S. EPA methods (Siepmann and Yargeau, 1996; Menconi and Siepmann, 1996, respectively).

Table 6. Concentrations (μg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 1991 and 1992 summer seasons.

				Endosulfan[a]		
Date	Site	Organophosphate[a]	Carbamate[a]	I	II	Sulfate
07-02-91	7a	ND[b]	ND	ND	ND	ND
	10	ND	ND	ND	ND	ND
	12	ND	ND	ND	ND	0.012
07-09-91	7a	ND	ND	ND	ND	ND
	10	ND	ND	ND	ND	ND
	12	ND	Methiocarb 0.06	ND	ND	0.012
07-16-91	7a	Azinphos-methyl 0.18	Methomyl 0.12	ND	ND	ND
	10	ND	ND	ND	ND	0.009
	12	Dimethoate 0.11	Methomyl 0.16	ND	ND	0.010
Rinse[c]		ND	ND	ND	ND	ND
07-23-91	7a	ND	Methomyl 0.42	ND	ND	0.006
	10	ND	Methomyl 0.27	ND	ND	ND
	12	ND	Methomyl 0.07	ND	ND	0.006
07-30-91	7a	ND	Methomyl 0.32	ND	ND	ND
	10	Dimethoate 0.08	Methomyl 0.14	ND	ND	ND
	12	Dimethoate 0.10	Methomyl 0.21	ND	ND	0.012
08-02-91	7a	ND, d, ND[e]	Methomyl 0.09, 0.09	ND	ND	ND
	10	Methidathion 0.10, 0.11, d	Methomyl 0.11, 0.17	ND	ND	ND
	12	Dimethoate 0.08, 0.09, d	Methomyl 0.10, 0.07	ND	ND	0.008

Table 6. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 1991 and 1992 summer seasons.

Date	Site	Organophosphate[a]	Carbamate[a]	Endosulfan[a] I	II	Sulfate
Rinse		ND, d	ND	ND	ND	ND
08-06-91	7a	Dimethoate 0.12, d	Methomyl 0.13	ND	ND	ND
	10	Dimethoate 0.12, d	Methomyl 0.11	ND	ND	ND
	12	Dimethoate 0.18, d	Methomyl 0.09	ND	ND	0.011
08-09-91	7a	ND, ND	Methomyl 0.07, 0.07	ND	ND	ND
	10	Dimethoate 0.08, 0.07	Methomyl 0.16, 0.16	ND	ND	0.008
	12	Dimethoate 0.15, 0.15	Methomyl 0.76, 1.2	ND	ND	0.020
08-13-91	7a	ND	Methomyl 0.14	ND	ND	ND
	10	Dimethoate 0.10	Methomyl 0.10	ND	ND	0.006
	12	Dimethoate 0.12	Methomyl 0.09	ND	ND	0.013
08-16-91	7a	ND, ND	Methomyl 0.10, 0.06	ND	ND	ND
	10	Dimethoate 0.09, 0.09	Methomyl 0.20, 0.14 Carbaryl 0.05, ND	ND	ND	0.006
	12	Dimethoate 0.58, 0.54	Methomyl 0.10, 0.08	ND	ND	0.011
Rinse		ND	ND	ND	ND	ND
08-20-91	7a	Dimethoate 0.14	Methomyl 0.37	ND	ND	ND
	10	Dimethoate 0.28	Methomyl 0.07	ND	ND	ND
	12	Dimethoate 0.15	Methomyl 0.19	ND	ND	0.010

Table 6. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 1991 and 1992 summer seasons.

				Endosulfan[a]		
Date	Site	Organophosphate[a]	Carbamate[a]	I	II	Sulfate
08-23-9 1	7a	Dimethoatd 0.05, 0.05	Methomyl 0.18, 0. 18	ND	ND	ND
	10	Dimethoate 0.78, 0.80	Methomyl 0.10, 0.15	ND	ND	ND
	12	Dimethoate 0.12, 0.12	Methomyl 0.12, 0.14	ND	ND	0.008
08-27-g 1	7a	ND	Aldicarb sulfoxide 0.05 Methomyl 0.20	ND	ND	ND
	10	Dimethoate 0.11	Methomyl 0.19	ND	ND	0.005
	12	Dimethoate 0.10	Methomyl 0.06	ND	ND	0.006
08-30-91	7a	Dimethoate 0.05, 0.05	Methomyl 0.22, 0.23	ND	ND	ND
	10	Dimethoate 0.29, 0.28	Methomyl 0.12, 0.14	ND	ND	ND
	12	Dimethoate 0.13, 0.13	Methomyl 1.8, 2.0	ND	ND	0.008
Rinse		ND	ND	ND	ND	ND
09-03-9 1	7a	Dimethoate 0.07	Methomyl 0.27	ND	ND	ND
	10	Dimethoate 0.06	Methomvl 0.10	ND	ND	ND
	12	Dimethoate 0.10	Methomyl 0.14	ND	ND	0.009
09-06-91	7a	Dimethoate 0.10	Methomyl 0.08	ND	ND	ND
	10	Dimethoate 1 .O	Methomvl 0.17	ND	ND	ND
	12	Dimethoate 0.06	Methomyl 0.16	ND	ND	0.011

Table 6. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 1991 and 1992 summer seasons.

				Endosulfan[a]		
Date	Site	Organophosphate[a]	Carbamate[a]	I	II	Sulfate
09-10-91	7a	ND	Methomyl 0.16	ND	ND	ND
	10	Dimethoate 0.13	Methomyl 0.15	ND	ND	ND
	12	Dimethoate 0.06	Carbaryl 0.05 Methomyl 0.24	ND	ND	0.005
09-13-91	7a	Dimethoate 0.12, 0.12	Methomyl 0.14, 0.14	ND	ND	ND
	10	Dimethoate 0.11, 0.10	Methomyl 0.12, 0.12	ND	ND	ND
	12	Dimethoate 0.13, 0.14	Methomyl 0.12, 0.11	ND	N-D	ND
Rinse		ND	N D	ND	ND	ND
07-08-92	7a	ND, f, g	Methomyl 0.05	ND	ND	ND
	10	ND, f, g	ND	ND,ND	ND, ND	0.010, 0.012
	12	ND, f, g	Methomyl 0.08	ND	ND	ND
07-15-92	7a	ND	Methomyl 0.18	ND	ND	ND, h
	10	Dimethoate 0.05	ND	ND, ND	ND, ND	0.014, 0.017, h
	12	Dimethoate 0.06	Methomyl 0.12	ND	ND	ND, h
07-22-92	7a	Azinphos-methyl 0.08, 0.09	Methomyl 0.08	ND	ND	ND
	10	ND	Methomyl 0.14	ND	ND	ND
	12	Dimethoate 0.10	ND, ND	ND	ND	ND

Table 6. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 1991 and 1992 summer seasons.						
				Endosulfan[a]		
Date	Site	Organophosphate[a]	Carbamate[a]	I	II	Sulfate
08-05-92	7a	Dimethoate 0.19, g	Methomyl 0.25, 0.25	ND	ND	ND
	10	Diazinon 0.18, g Dimethoate 0.06	Methomyl 0.12	ND	ND	ND
	12	Diazinon 0.21, g Dimethoate 0.15, 0.12	Methomyl 0.05	ND	ND	ND
08-12-92	7a	ND	Methomyl 0.08	ND	ND	ND
	10	ND	ND	ND	ND	ND
	12	Dimethoate 0.15, 0.13	Methomyl 0.05	ND	ND	ND
08-19-92	7a	Diazinon 0.07 Dimethoate 2.44	Methomyl 0.06	ND	ND	0.012, 0.010
	10	Dimethoate 0.05	ND	ND	ND	ND
	12	Chlorpyrifos 0.33, 0.35 Dimethoate 0.06, 0.07	Methomyl 0.05	ND	ND	ND
09-02-92	7a	Dimethoate 0.80	Methomyl 0.06, 0.08	ND	ND	ND
	10	Dimethoate 0.09	Methomyl 0.10	ND	ND	ND
	12	Dimethoate 0.11	Methomyl 0.20	ND	ND	ND

Table 6. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected from the San Joaquin River during the 199 1 and 1992 summer seasons.

				Endosulfan[a]		
Date	Site	Organophosphate[a]	Carbamate[a]	I	II	Sulfate
09-09-92	7a	Dimethoate 0.19	ND	ND	ND	ND
	10	Dimethoate 0.05	Methomyl 0.08	ND	N D	ND
Rinse		N D	ND	ND	ND	ND
	12	Dimethoate 0.19	Methomyl 0.16, 0.16	ND	ND	ND

a. All pesticides in the organophosphate, carbamate, and endosulfan screens are listed in Tables 2 and 3. Diazinon and diazinon oxon were analyzed with, endosulfan in 1992. See text for explanation.
b. ND = none detected. Method detection limits are listed in Tables 2 and 3.
c. Rinse sample. Equipment rinse water was used to monitor cross contamination between sampling sites.
d. Companion quality control spike was low for phosmet.
e. A split sample was analyzed where two values appear.
f. Companion quality control spike was low for ethoprop.
g. Companion quality control spike was low for fonofos.
h. Companion quality control spike was low for diazinon oxon.

Table 7. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected during the 18-site surveys conducted in the summer of 1992.

				Endosulfan[a]		
Date	Site	Organophosphates[a]	Carbamates[a]	I	II	sulfate
07-27-92	1	ND[b], c, d	ND	ND	ND	ND
07-27-92	2	ND, c, d	Methomyl 0.13	ND	ND	ND
07-28-92	18	ND, c, d	Methiocarb 0.08	ND	ND	ND
07-27-92	3	ND, c, d	Methomyl 0.13	ND	ND	ND
07-27-92	4	No water in Los Banos Creek at the time of sampling.				
07-28-92	5	Dimethoate 0.23, c, d	ND	ND	ND	ND
07-28-92	6	ND, c, d	ND	ND	ND	ND
07-28-92	7	ND, c, d	ND	ND	ND	ND
07-28-92	Rinse[e]	ND, c, d	ND	ND	ND	ND
07-29-92	8	Azinphos-methyl 0.08 Diazinon 0.08 Dimethoate 0.58	Methomyl 0.06	ND	ND	ND
07-29-92	9	ND	ND	ND	ND	ND
07-29-92	10	Dimethoate 0.06	Methomyl 0.08	ND	ND	ND
07-29-92	11	Dimethoate 0.94	Methomyl 0.47	ND	ND	ND
07-30-92	12	Dimethoate 0.22	Methomyl 0.16	ND	ND	ND
07-30-92	13	ND, c, d	ND	ND	ND	ND
07-3 l-92	14	Dimethoate 0.34, c, d	Methomyl 0.19	ND	0.008	0.045
07-3 l-92	15	Dimethoate 0.18, c, d	Methomyl 0.10	ND	ND	ND
07-30-92	16	ND, c, d	ND	ND	ND	ND
07-3 l-92	17	Dimethoate 0.10, c, d	Methomyl 0.05	ND	ND	ND
07-3 1-92	Rinse	ND, c, d	ND	ND	ND	ND
08-24-92	1	ND	ND	ND	ND	ND
08-24-92	2	Diazinon 0.17	Methomyl 0.06	ND	ND	0.018
08-25-92	18	Diazinon 0.28, 0.32[f]	ND	ND	ND	0.014, 0.011
08-24-92	3	ND	ND	ND	ND	0.019
08-24-92	4	No water in Los Banos Creek at the time of sampling.				
08-25-92	5	Dimethoate 0.88	ND	ND	ND	ND
08-[illegible]	6	ND	ND	ND	ND	ND

Table 7. Concentrations (µg/L) of organophosphates, carbamates, and endosulfan in water collected during the 18-site surveys conducted in the summer of 1992.

Date	Site	Organophosphates[a]	Carbamates[a]	Endosulfan[a] I	Endosulfan[a] II	Endosulfan[a] sulfate
08-25-92	7	Diazinon 0.07 Dimethoate 0.06	ND	ND	ND	ND
08-25-92	Rinse	ND	ND	ND	ND	ND
08-26-92	8	Azinphos-methyl 0.10 Dimethoate 0.61	Methomyl 0.20, g	ND	ND	0.017
08-26-92	9	ND	Carbaryl 0.20, g	ND	ND	ND
08-26-92	10	Diazinon 0.06 Dimethoate 0.07	Methomyl 0.09, g	ND	ND	ND
08-27-92	11	ND	ND, g	ND	ND	ND
08-27-92	12	Dimethoate 0.07	Methomyl 0.13, g	ND	ND	ND
08-28-92	13	ND	ND, g	ND	ND	ND
08-28-92	14	Dimethoate 0.36	Methomyl 0.29	ND	ND	0.014
08-28-92	Rinse	ND	ND	ND	ND	ND
08-28-92	15	Dimethoate 0.10	Methomyl 0.18	ND	ND	ND
08-27-92	16	ND	ND, g	ND	ND	ND
08-28-92	17	Dimethoate 0.06	ND	ND	ND	ND

a. All pesticides in the organophosphate and carbamate screens are listed in Tables 2 and 3.
Diazinon and diazinon oxon were analyzed with endosulfan in 1992. See text for explanation.
b. None detected. Method detection limits are listed in Tables 2 and 3.
c. Companion quality control spike was low for fonofos.
d. Companion quality control spike was low for phosmet.
e. Rinse sample. Equipment rinse samples were analyzed to determine if cross contamination occurred between sampling sites.
f. Duplicate (split) sample analyzed.
g. Companion quality control spike was low for aldicarb SO,.

Table 8. Use of insecticides (lbs) in Merced, Stanislaus, and San Joaquin counties during the months of June, July, and August of 1991 and 1992. Use is summarized for the most frequently detected insecticides.

	Organophosphates			Carbamates		
County/Date	Azinphos-methyl	Diazinon	Dimethoate	Carbaryl	Methomyl	Endosulfan
Merced						
June '91	9,270	3,070	6,480	6,290	2,880	NRU[a]
July '91	27,700	1,570	1,490	4,850	7,090	24
August '91	3,820	1,280	1,950	2,950	9,560	1,490
June '92	19,600	2,100	4,370	6,260	4,670	5
July '92	11,300	4,600	2,710	6,400	7,400	367
August '92	2,880	3,430	2,140	3,310	8,620	139
Stanislaus						
June '91	6,660	1,620	2,470	3,390	608	1,120
July '91	26,200	2,750	10,800	5,250	3,810	281
August '91	2,000	1,340	8,870	7,710	4,820	714
June '92	18,400	1,950	1,530	5,370	2,270	79
July '92	13,900	3,640	7,520	4,670	6,040	589
August '92	1,880	1,350	6,910	2,530	4,030	494
San Joaquin						
June '91	3,030	1,860	14,460	9,880	298	1,470
July '91	8,290	3,010	8,930	6,880	5,220	642
August '91	4,460	2,810	2,620	4,930	2,980	480
June '92	7,010	2,440	4,920	14,900	2,480	2,220
July '92	10,200	3,470	8,100	5,840	5,370	735
August '92	2,770	3,010	3,910	1,110	5,310	565

[a] NRU = no reported use.

Table 9. Physical and chemical properties of various insecticides detected in the San Joaquin River watershed during the 199 1 and 1992 summer seasons. Properties from the Department of Pesticide Regulation Chemistry Database (Kollman and Segawa, 1995).

Property	Azinphos-methyl	Carbaryl	Diazinon	Dimethoate	Methomyl	Endosulfan
Solubility(mg/L)	28 (20 °C)	113 (25°C) 116[a] (22°C)	60.0 (22°C)	39,800 (25 “C)	54,700 (25°C)	0.330 (22°C)
Hydrolysis Half-life at pH 7 (days)	19[a] (30°C) 10 - 25[b]	12 (25 “C)	138 (24°C)	68 (25 “C)	>30 (25°C)	15[a] (25°C) 11 - 19[b]
Aerobic Soil Metabolism Half-life (days)	44	5.5	40	2.4	46	32[a] (25°C) 26 - 38[b]
Soil Adsorption (K_{oc})	882[a] 694-1280[b]	308[a] 29-1958[b]	1581[a] 1054-1929[b]	1.3	44[a] 34 - 62[b]	12,594[a] 8345 - 22,414[b]
Field Dissipation Half-life (days)	8.1[a] 5 - 11[b]	9.5[a] 7-12[b]	14.2[a] 7-30[b]	7.9[a] 6-10[b]	30[a] 5-54[b]	88[a] 77-93[b]

a. Mean
b. Range

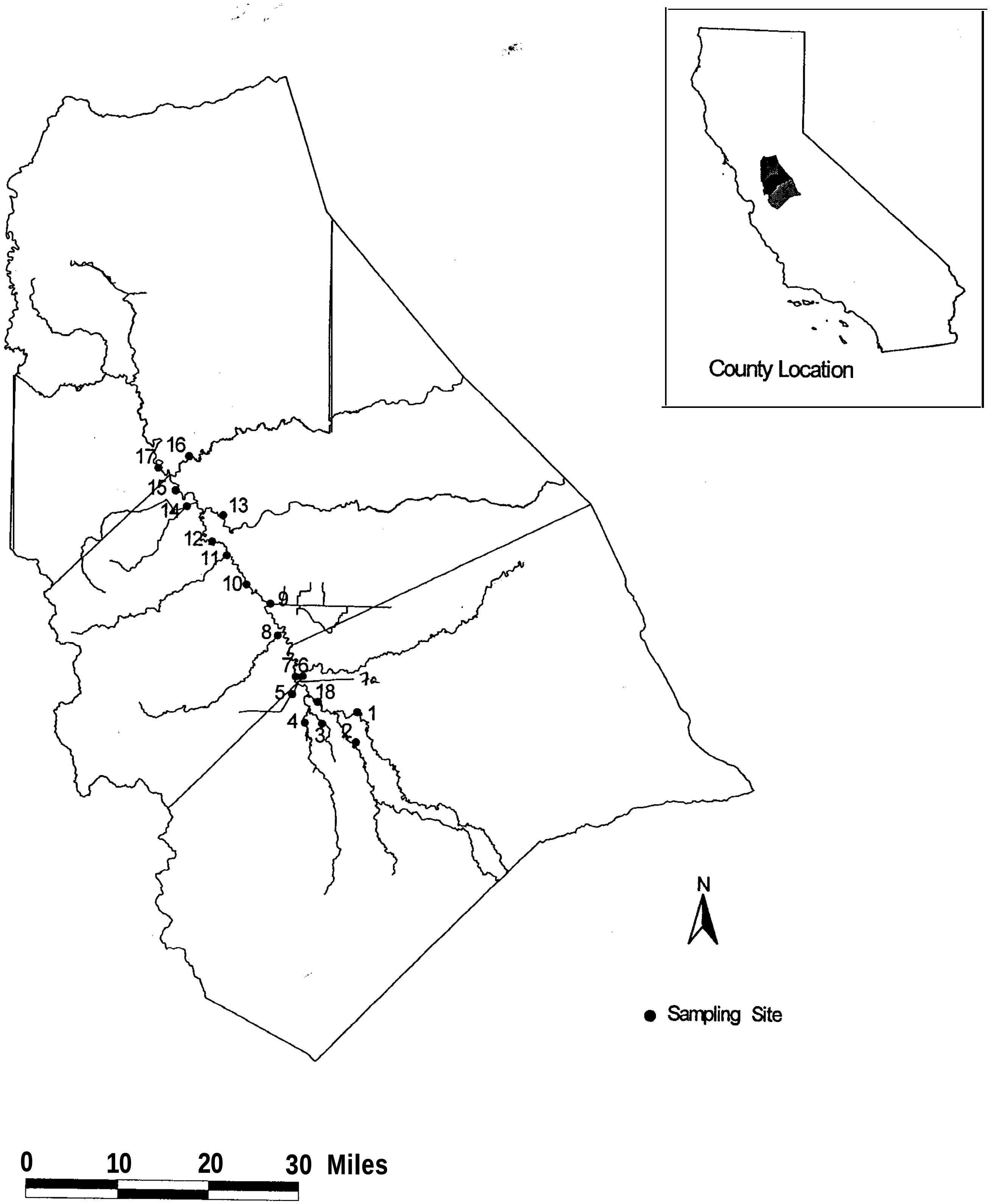


Figure 1. Sampling site locations in the San Joaquin River study area. See Table 1 for site names.

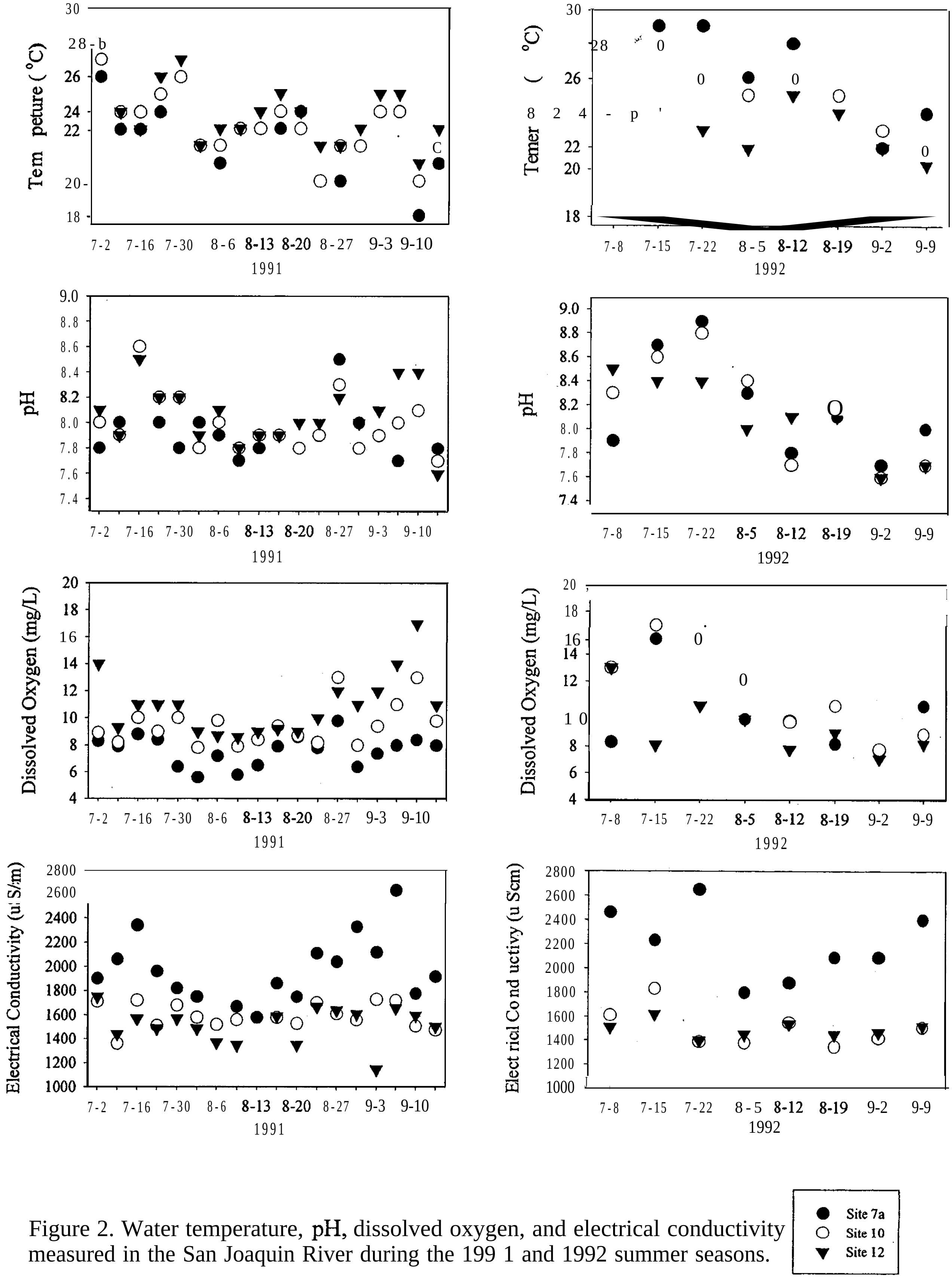


Figure 2. Water temperature, pH, dissolved oxygen, and electrical conductivity measured in the San Joaquin River during the 199 1 and 1992 summer seasons.

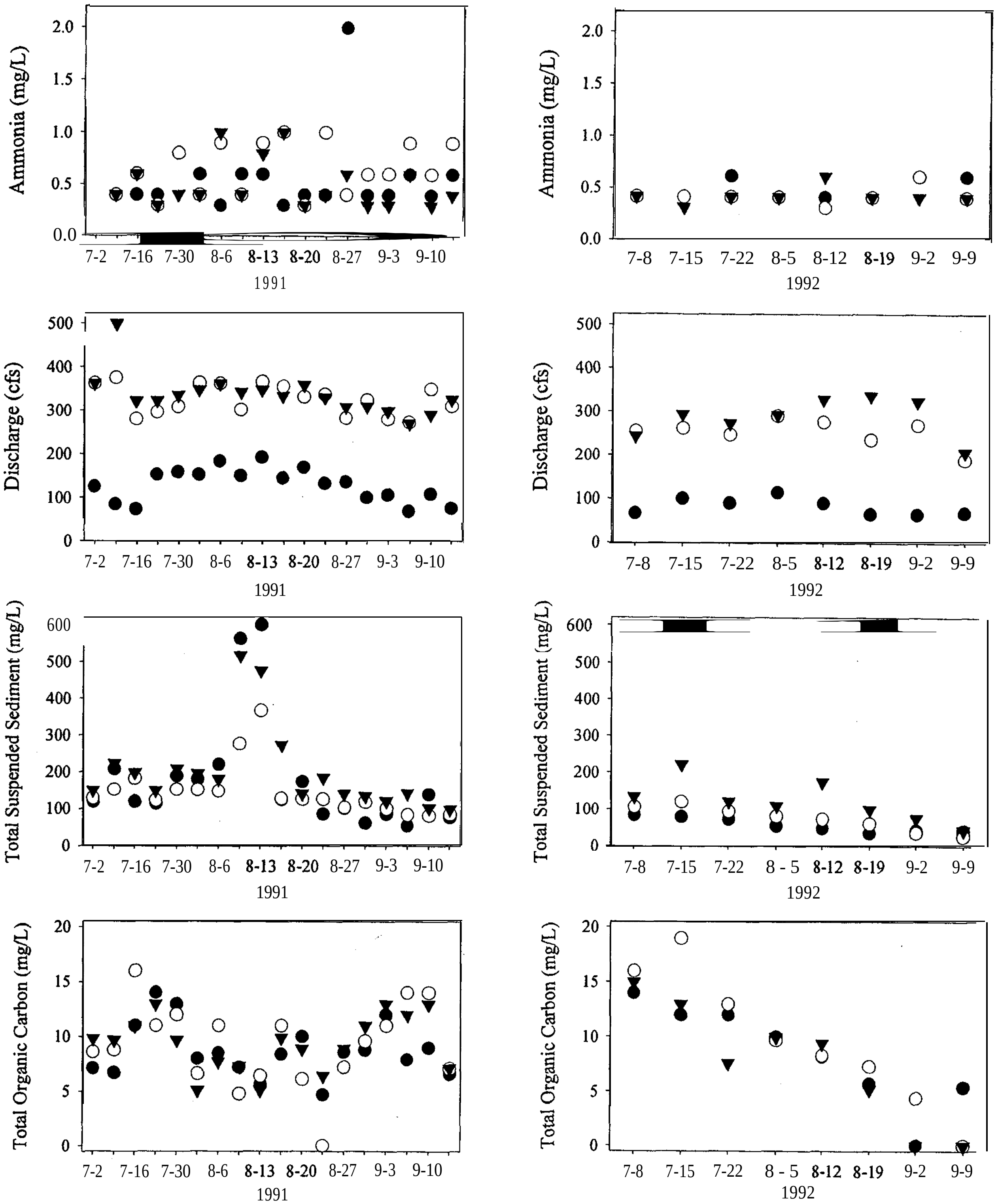
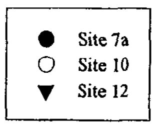


Figure 3. Total ammonia, discharge, total suspended sediment, and total organic carbon measured in the San Joaquin River during the 199 1 and 1992 summer seasons.



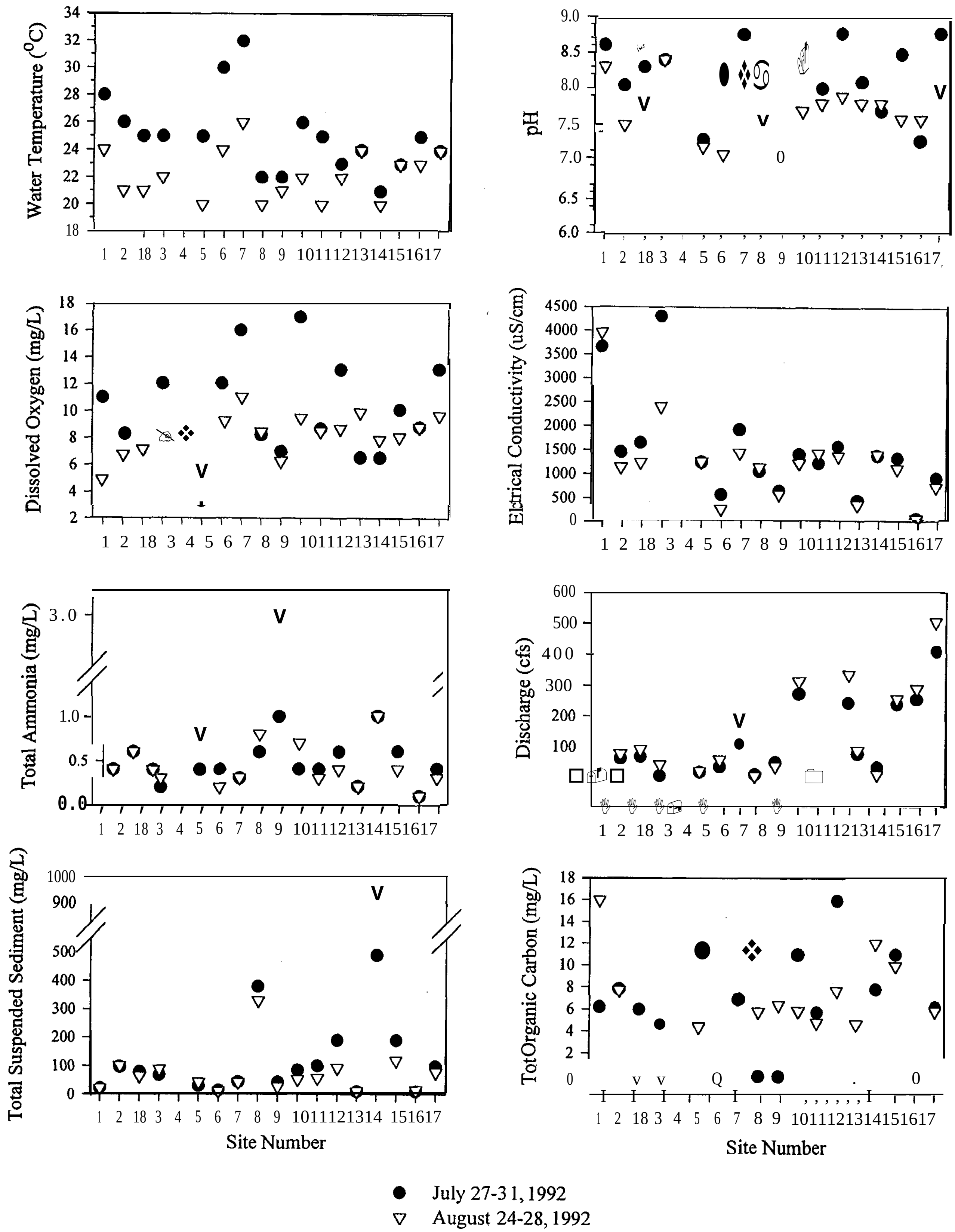


Figure 4. Water quality measurements made during the 18-site surveys conducted in the summer of 1992.

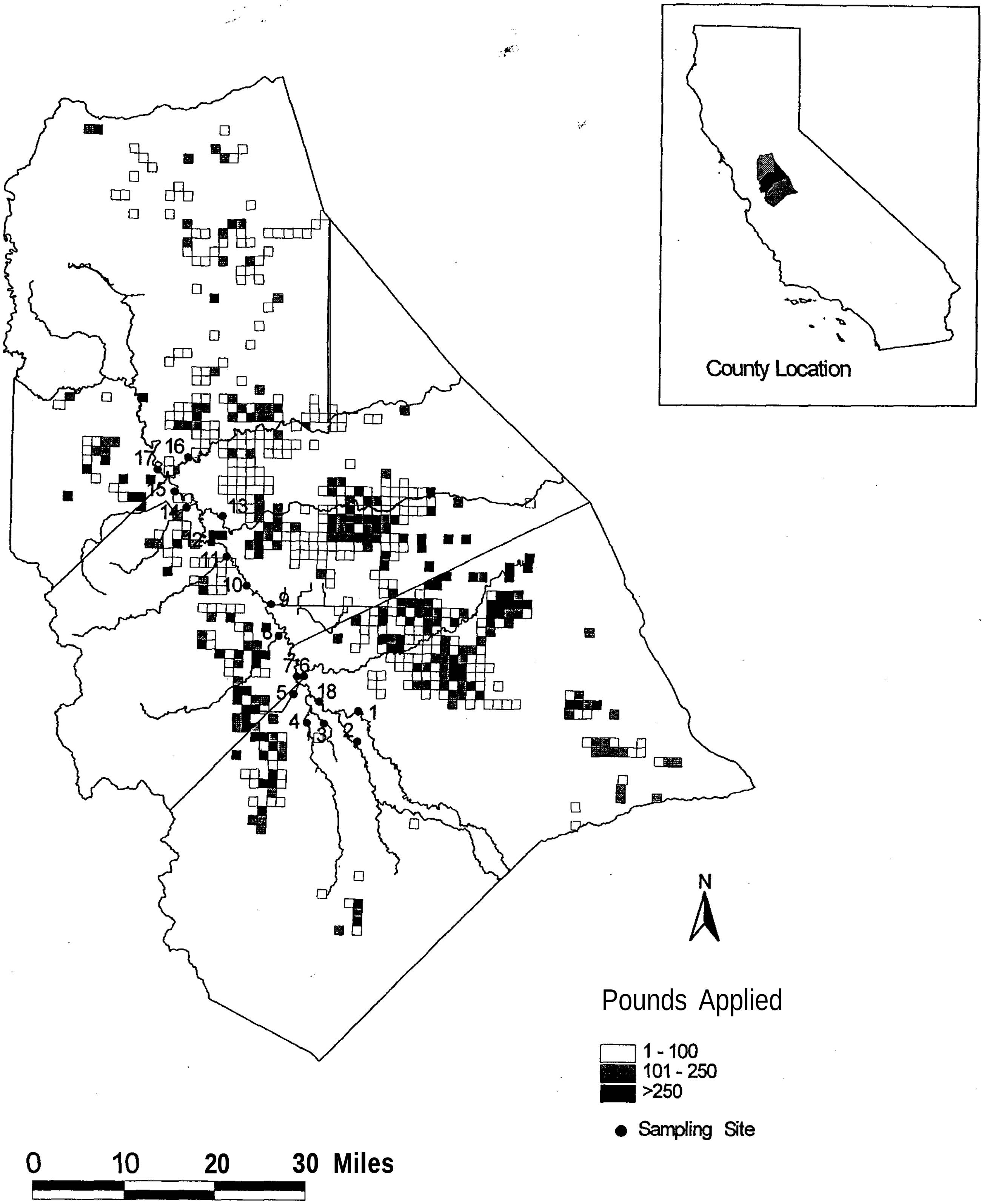


Figure 5. Azinphos-methyl use during June, July, and August of 1991.

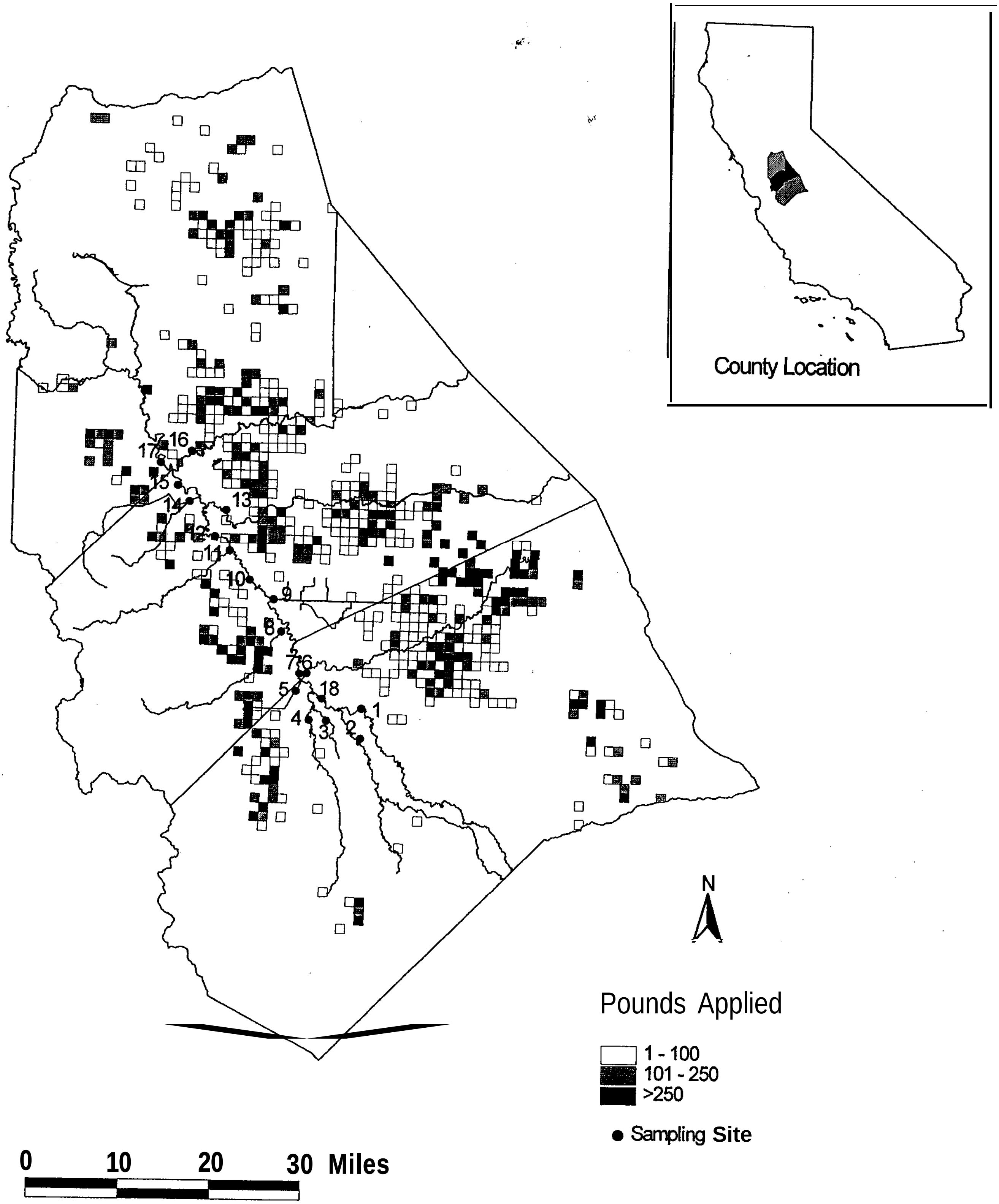


Figure 6. Azinphos-methyl use during June, July, and August of 1992.

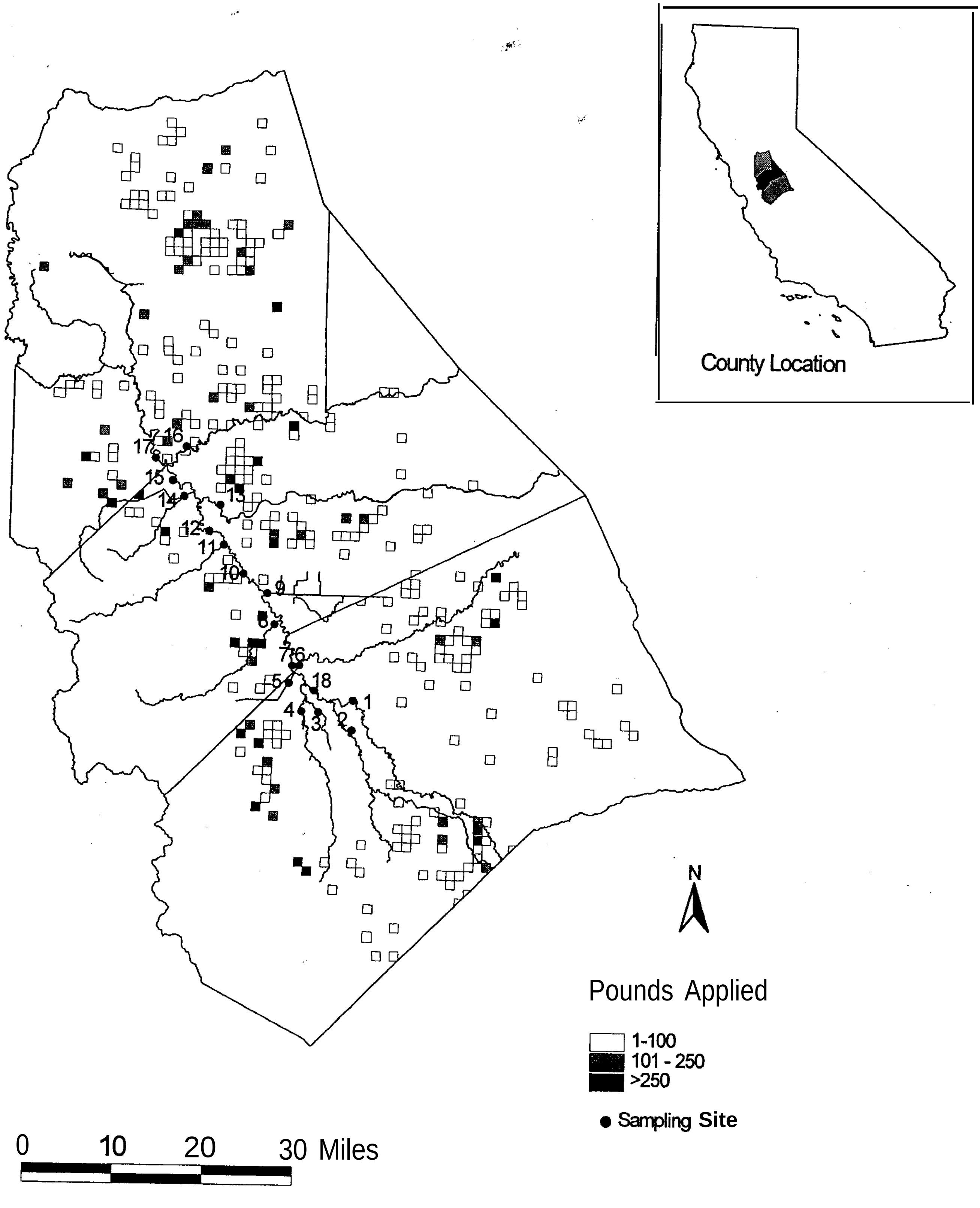


Figure 7. Diazinon use during June, July, and August of 1992.

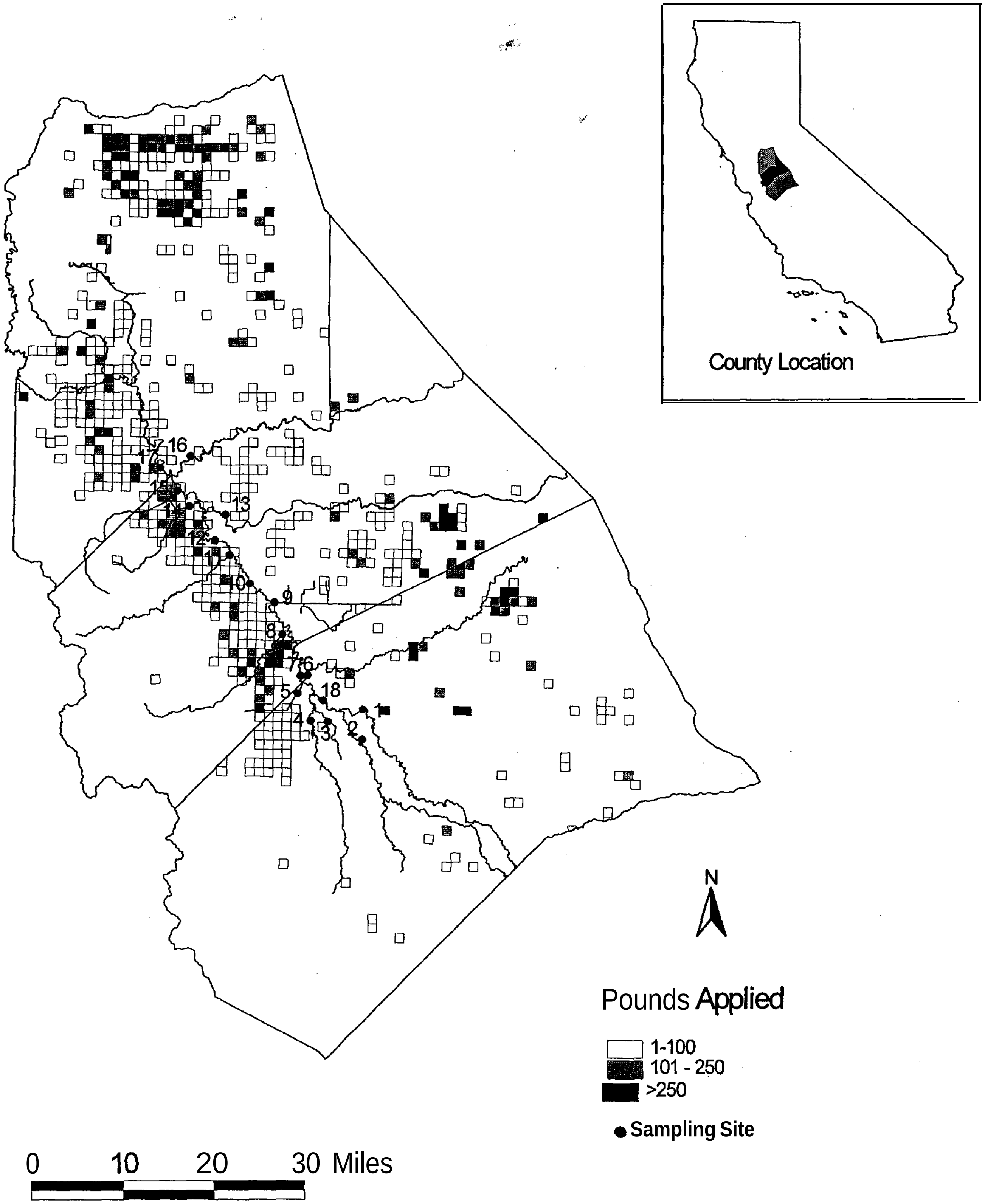


Figure 8. Dimethoate use during June, July, and August of 1991.

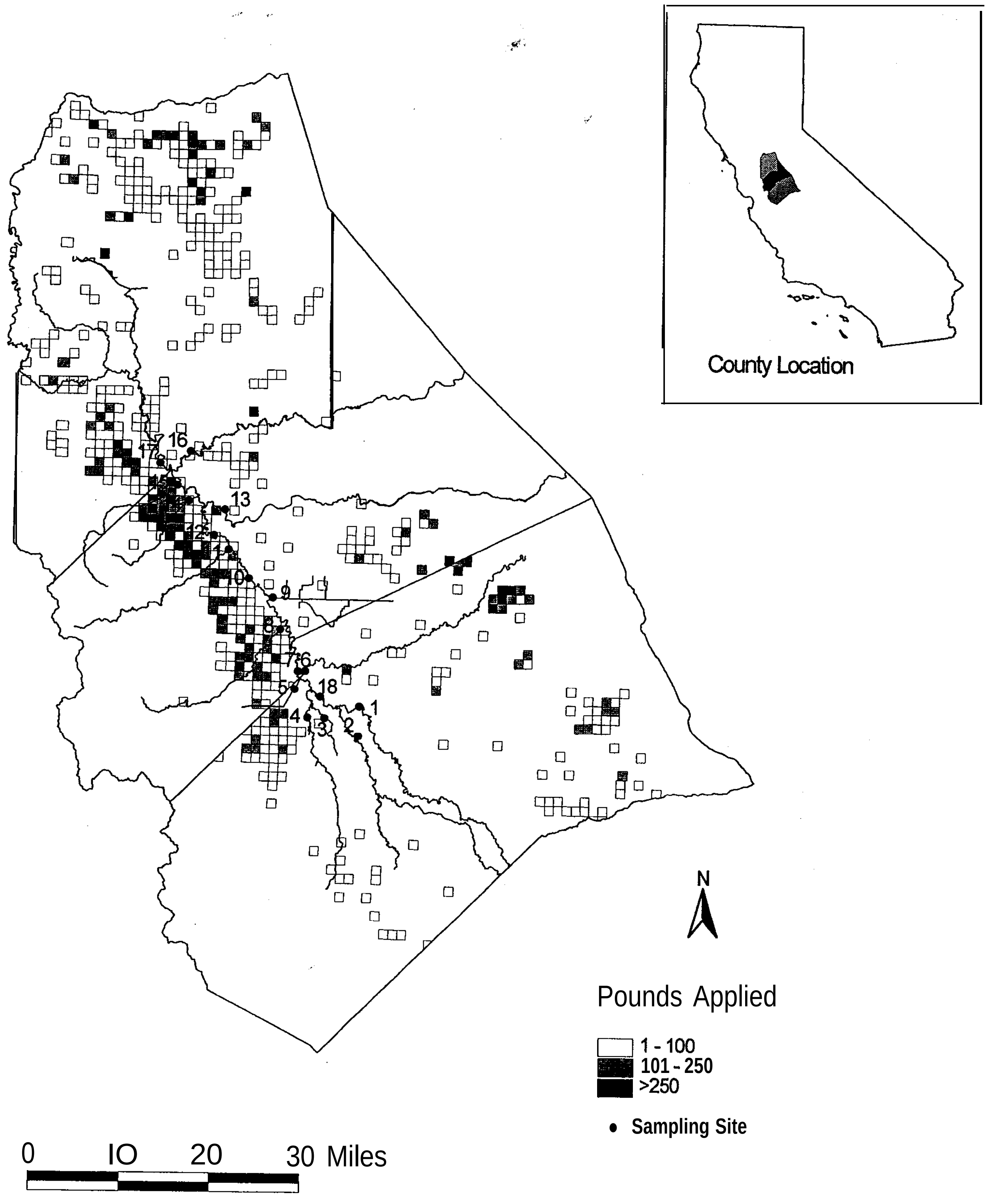


Figure 9. Dimethoate use during June, July, and August of 1992.

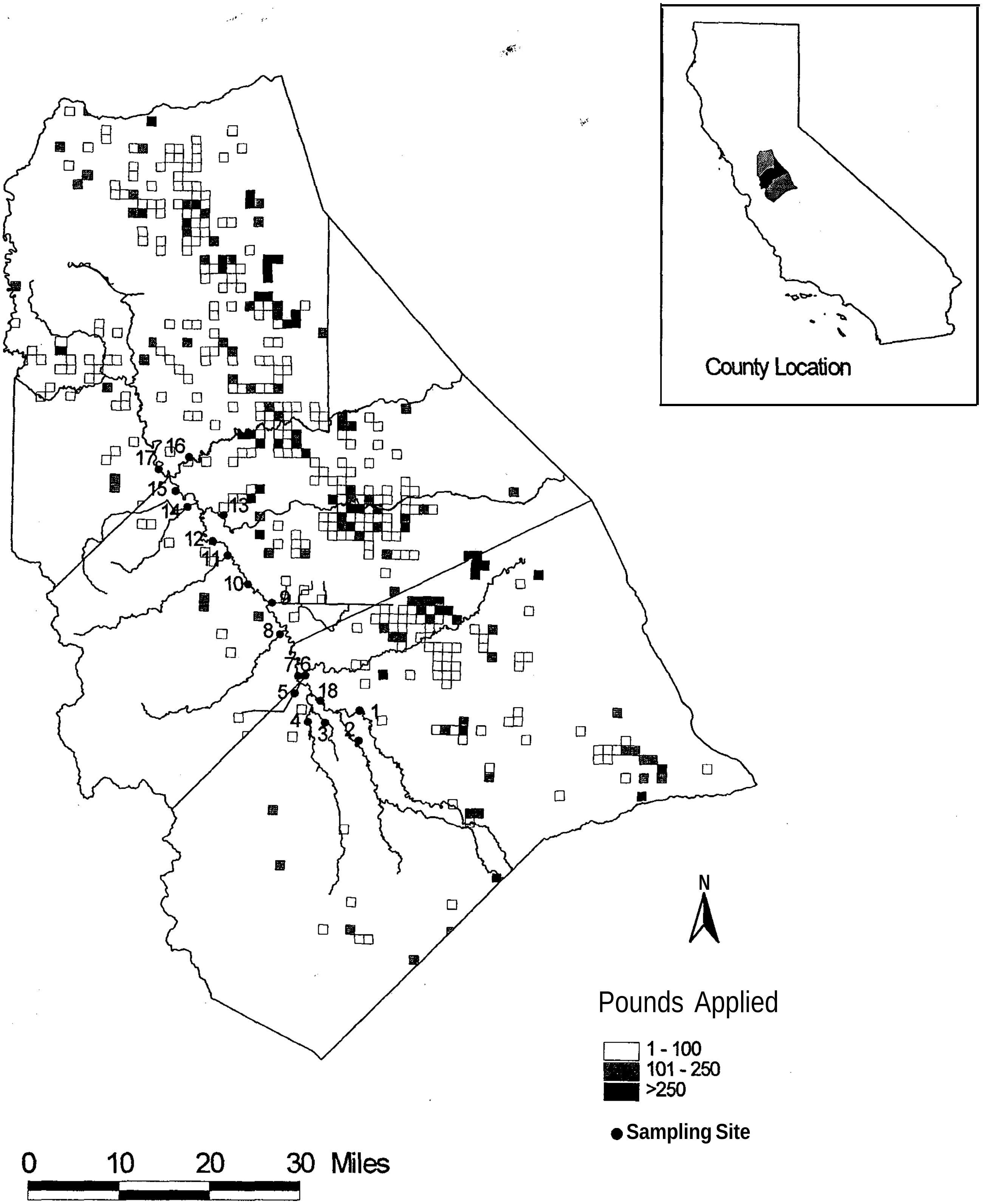


Figure 10. Carbaryl use during June, July, and August of 1991.

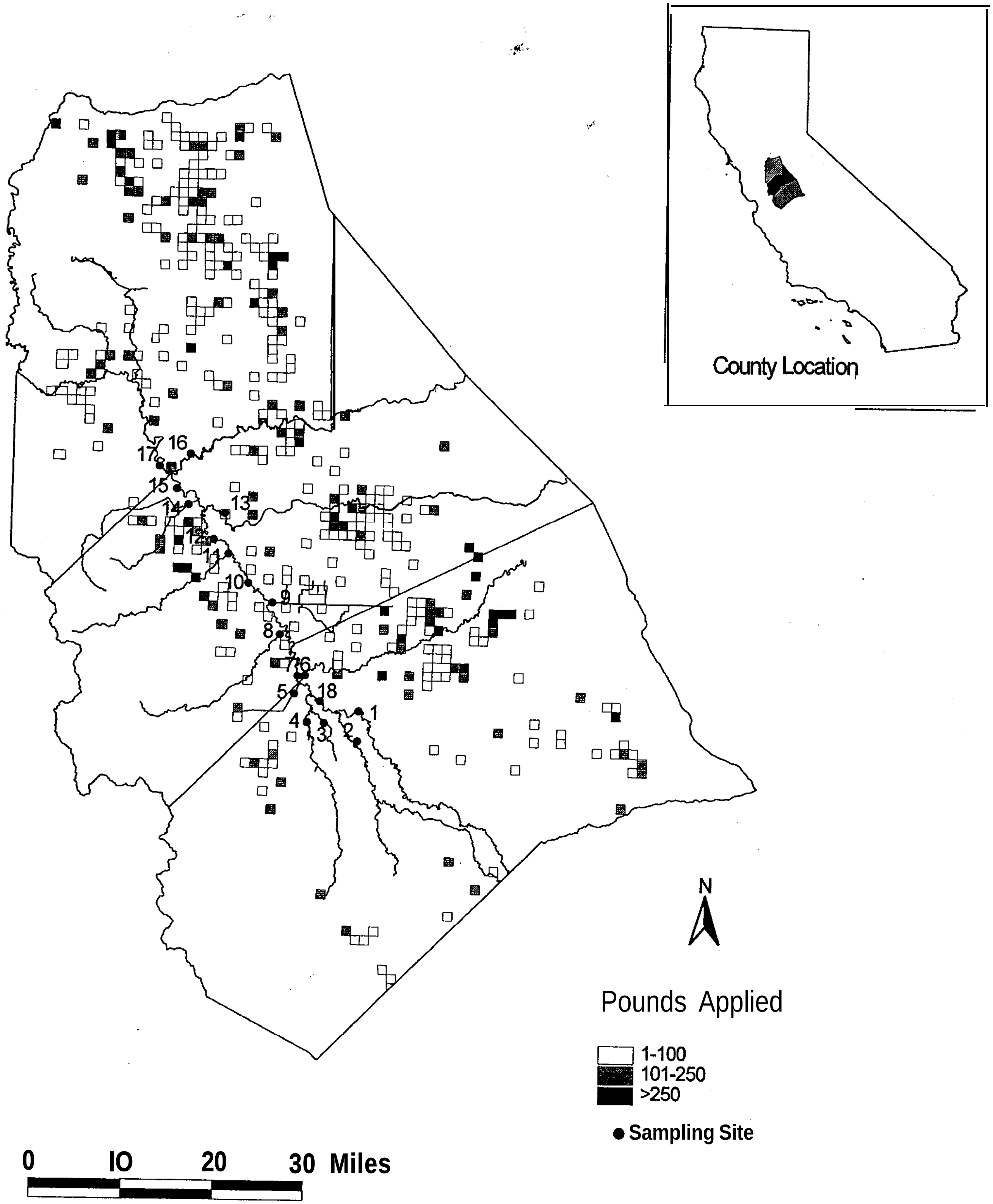


Figure 11. Carbaryl use during June, July, and August of 1992.

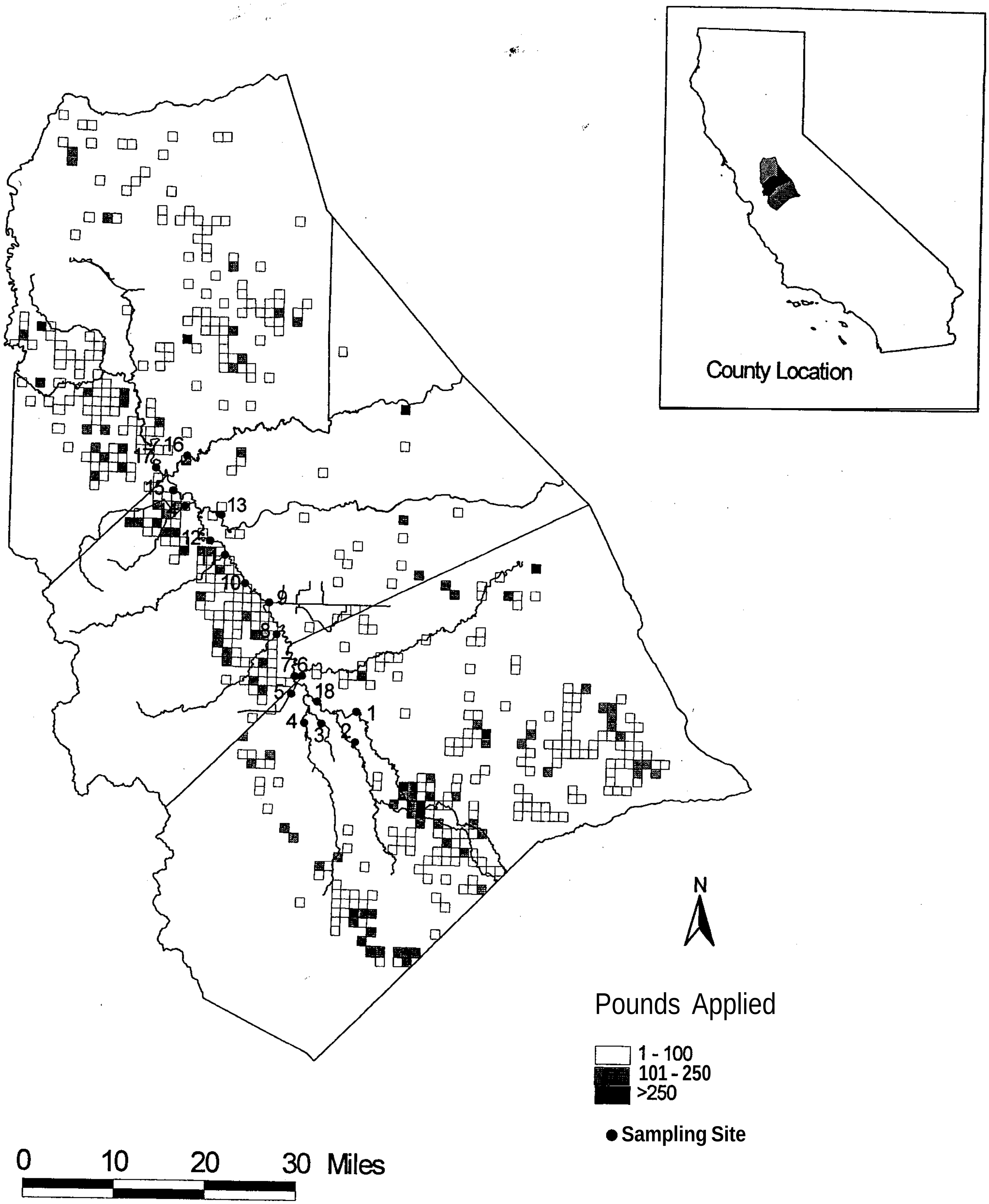


Figure 12. Methomyl use during June, July, and August of 1991.

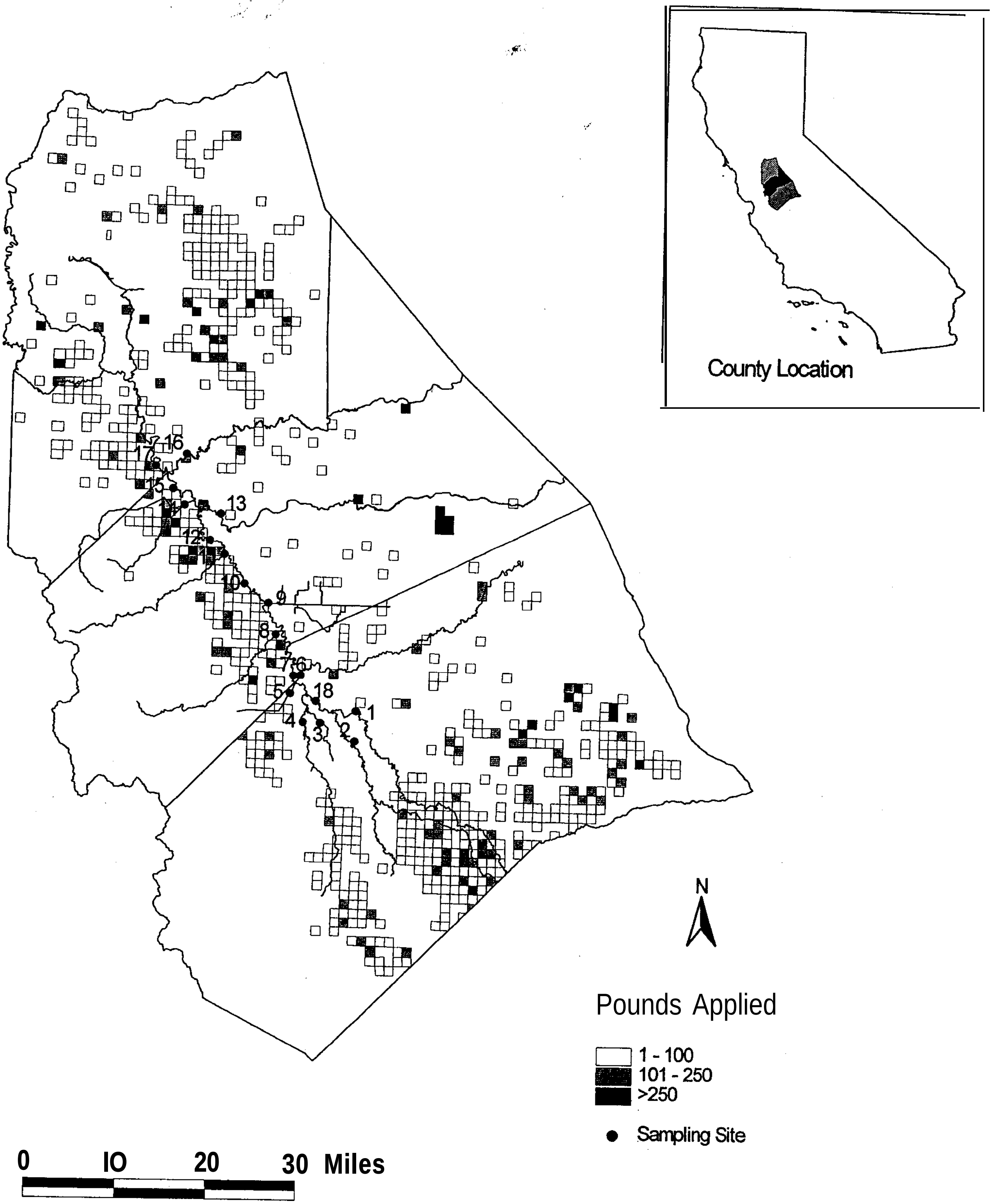


Figure 13. Methomyl use during June, July, and August of 1992.

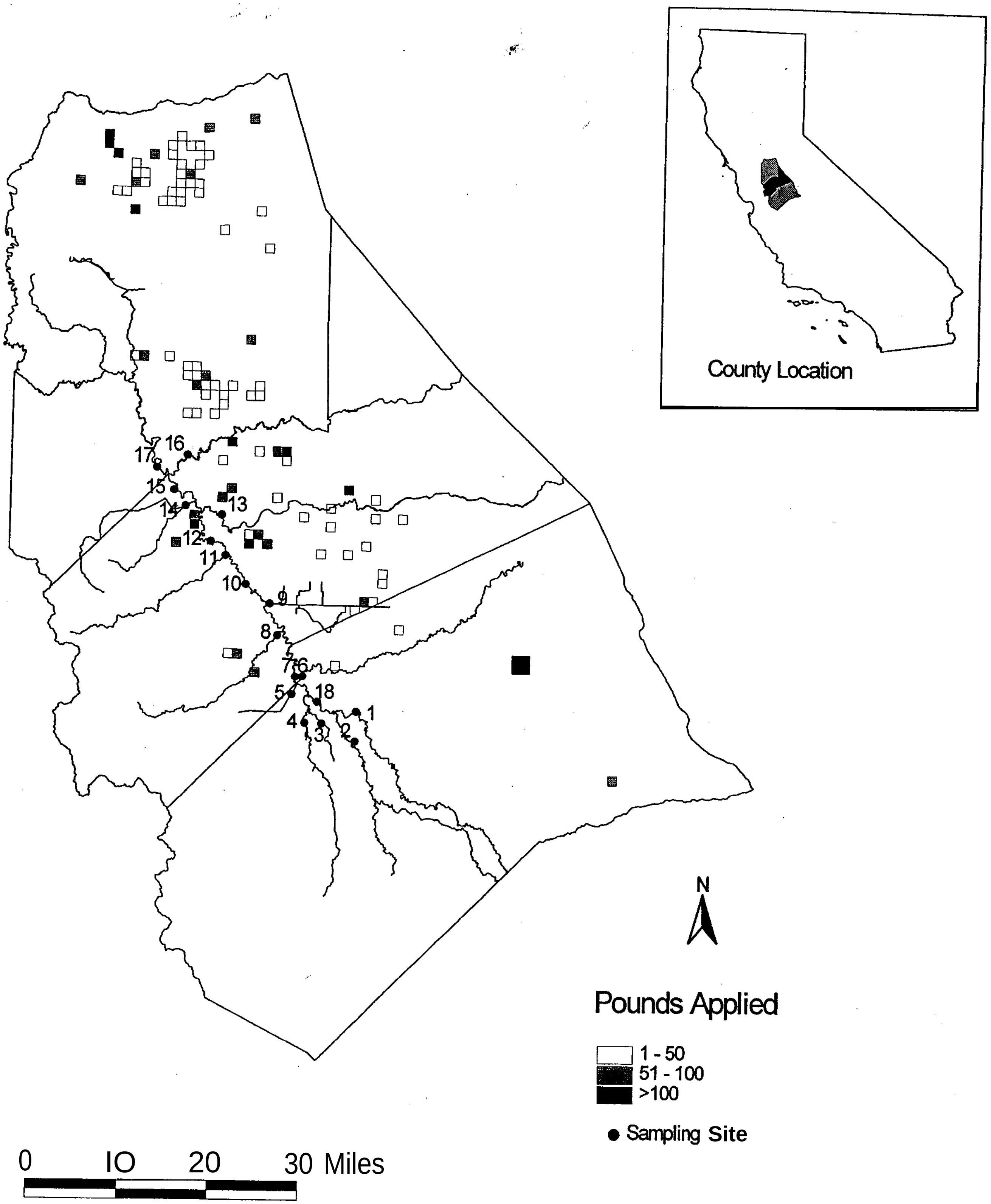


Figure 14. Endosulfan use during June, July, and August of 1991.

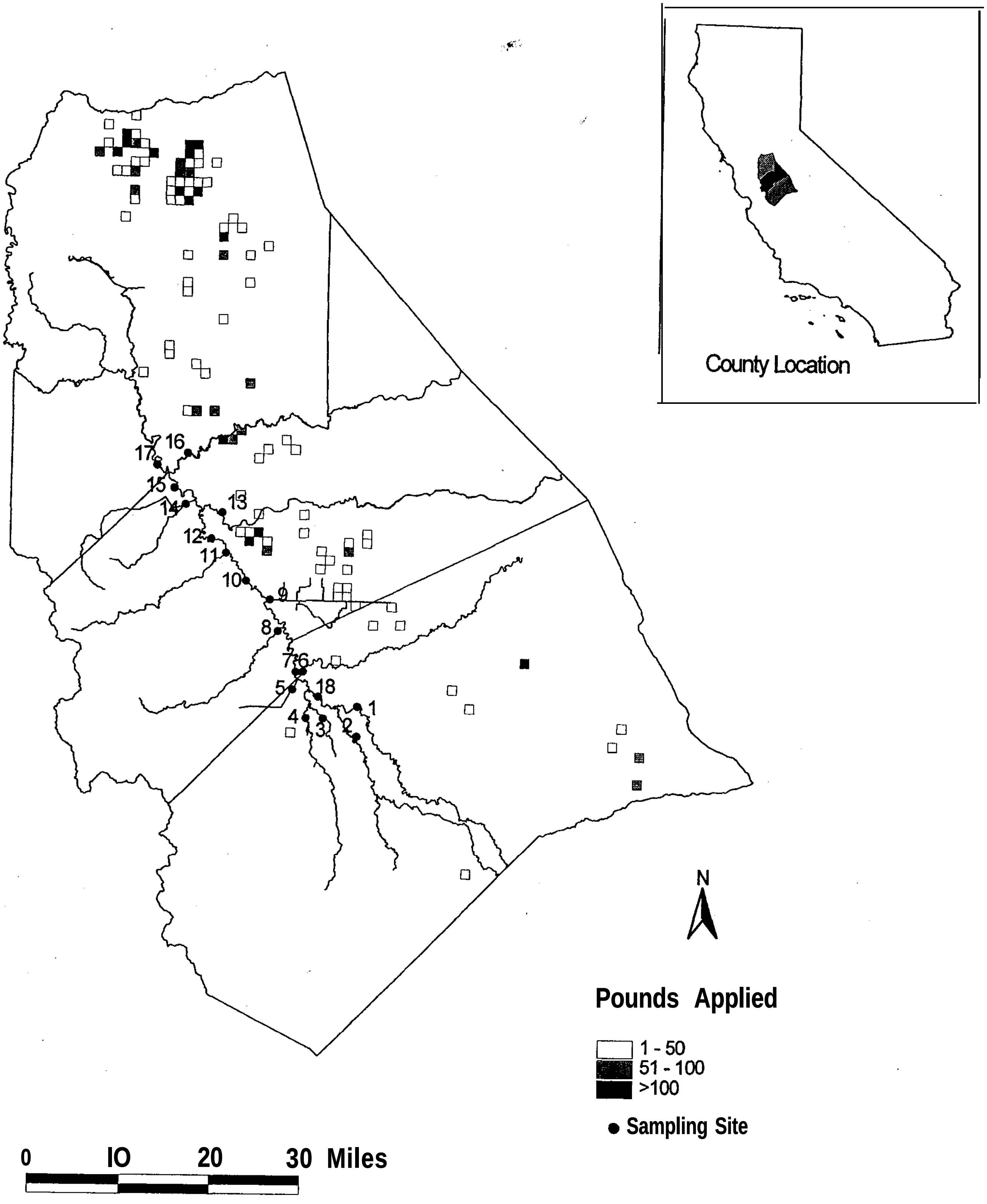


Figure 15. Endosulfan use during June, July, and August of 1992.

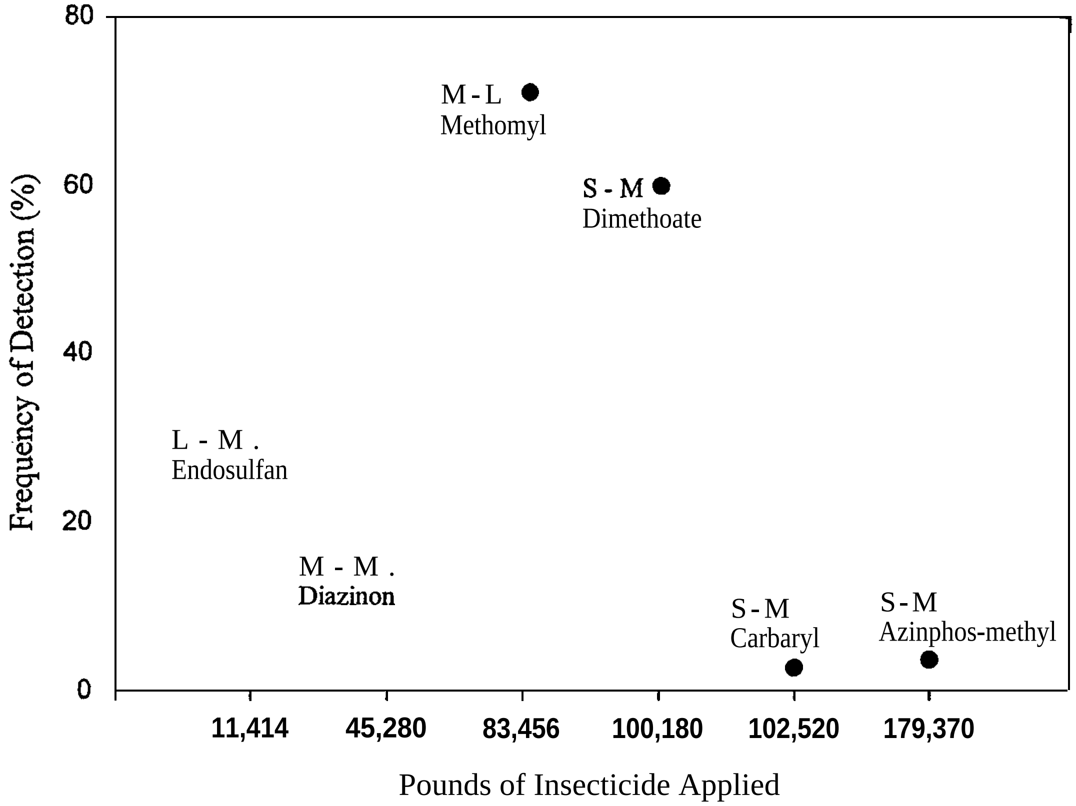


Figure 16. Insecticide use plotted against frequency of detection. The letters S, M, and L indicate small, medium, and large runoff potential, respectively. The first letter represents sediment-bound runoff potential, the second represents solution-phase runoff potential.

Appendix I. Continuing quality control.

Table 1. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate
Analyte:Azinphos-methyl
Minimum Detection Limit (MDL): 0.10 ppb

UCL = 117
uWL= 111
LWL = 87
LCL = 81

&ample Type: Surface Water
Lab: CDFA
Chemist: Jean Hsu

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.49	98
349, 403, 559, 580	0.5	0.55	110
295, 367, 415, 481	0.5	0.57	114
301, 335, 373	0.5	0.53	106
283, 288, 337	0.5	0.55	110
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.55	110
505, 523, 614	0.5	0.61	122**
608, 666, 644, 662, 650, 664	0.5	0.47	94
606, 620, 626, 630, 656, 668, 674	0.5	0.56	112
728, 740, 746	0.5	0.54	108
628, 734, 836, 854, 856, 860	0.5	0.53	106
686, 788, 842	0.5	0.49	98
596, 632, 638	0.5	0.52	104
680, 698, 716, 718, 722, 830, 858	0.5	0.52	104
770, 782, 908	0.5	0.54	108
692, 710, 818	0.5	0.55	110
704, 764, 800	0.5	0.51	102
720, 806, 878, 914, 920, 922, 932	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

** Matrix spike recovery fell above the upper control limit.

Table 2. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate
Analyte: Azinophos-methyl OA
MDL: 0.50 ppb

UCL = 114
UWL= 108
LWL= 84
LCL= 78

Sample Type: Surface Water
Lab: CDFA
Chemist: Jean Hsu

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.53	106
349, 403, 559, 580	0.5	0.46	92
295, 367, 415, 481	0.5	0.47	94
301, 335, 373	0.5	0.57	114
283, 288, 337	0.5	0.46	92
606, 620, 626, 630, 656, 668, 674	0.5	0.55	110
728, 740, 746	0.5	0.46	92
628, 734, 836, 854, 856, 860	0.5	0.49	98
686, 788, 842	0.5	0.55	110
596, 632, 638	0.5	0.49	98
680, 698, 716, 718, 722, 830, 858	0.5	0.52	104
770, 782, 908	0.5	0.43	86
692, 710, 818	0.5	0.48	96
704, 764, 800	0.5	0.53	106
720, 806, 878, 914, 920, 922, 932	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 3. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 116	Sample Type: Surface Water
Analyte: Chlorpyrifos	UWL = 110	'Lab: CDFA
MDL: 0.05 ppb	LWL= 83	Chemist: Jean Hsu
	LCL= 76	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
573	1.0	1.00	100
343, 348, 487, 579	0.5	0.41	82
349, 403, 559, 580	0.5	0.47	94
295, 367, 415, 481	0.5	0.50	100
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.49	98
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.49	98
505, 523, 614	0.5	0.48	96
608, 666, 644, 662, 650, 664	0.5	0.48	96
606, 620, 626, 630, 656, 668, 674	0.5	0.47	94
728, 740, 746	0.5	0.47	94
628, 734, 836, 854, 856, 860	0.5	0.44	88
686, 788, 842	0.5	0.44	88
596, 632, 638	0.5	0.48	96
680, 698, 716, 718, 722, 830, 858	0.5	0.50	100
770, 782, 908	0.5	0.46	92
692, 710, 818	0.5	0.50	100
704, 764, 800	0.5	0.48	96
720, 806, 878, 914, 920, 922, 932	0.5	0.47	94

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 4, Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL = 121	Sample Type: Surface Water
Analyte: Chlorpyrifos OA	uwL= 113	Lab: CDFA
MDL: 0.30 ppb	LWL= 80	Chemist: Jean Hsu
	LCL= 72	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.45	90
349, 403, 559, 580	0.5	0.45	90
295, 367, 415, 481	0.5	0.44	88
301, 335, 373	0.5	0.53	106
283, 288, 337	0.5	0.48	96
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.45	90
505, 523, 614	0.5	0.53	106
608, 666, 644, 662, 650, 664	0.5	0.47	94
606, 620, 626, 630, 656, 668, 674	0.5	0.52	104
728, 740, 746	0.5	0.56	112
628, 734, 836, 854, 856, 860	0.5	0.49	98
686, 788, 842	0.5	0.51	102
596, 632, 638	0.5	0.47	94
680, 698, 716, 718, 722, 830, 858	0.5	0.44	88
770, 782, 908	0.5	0.52	104
692, 710, 818	0.5	0.45	90
704, 764, 800	0.5	0.52	104
720, 806, 878, 914, 920, 922, 932	0.5	0.54	108

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 5. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL = 123	Sample Type: Surface Water	
Analyte: DDVP	UWL= 115	Lab:' CDFA	
MDL: 0.05 ppb	LWL= 82	Chemist: Jean Hsu	
	LCL = 73		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.47	94
349, 403, 559, 580	0.5	0.43	86
295, 367, 415, 481	0.5	0.41	82
301, 335, 373	0.5	0.48	96
283, 288, 337	0.5	0.37	74
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.43	86
505, 523, 614	0.5	0.42	84
608, 666, 644, 662, 650, 664	0.5	0.42	84
606, 620, 626, 630, 656, 668, 674	0.5	0.42	84
728, 740, 746	0.5	0.47	94
628, 734, 836, 854, 856, 860	0.5	0.47	94
686, 788, 842	0.5	0.44	88
596, 632, 638	0.5	0.41	82
680, 698, 716, 718, 722, 830, 858	0.5	0.46	92
770, 782, 908	0.5	0.44	88
692, 710, 818	0.5	0.43	86
704, 764, 800	0.5	0.45	90
720, 806, 878, 914, 920, 922, 932	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 6. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL = 122	Sample Type: Surface Water	
Analyte: Diazinon	UWL = 113	Lab: CDFA	
MDL: 0.05 ppb	LWL= 78	Chemist: Jean Hsu	
	LCL= 69		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
573	1.0	1.02	102
343, 348, 487, 579	0.5	0.49	98
349, 403, 559, 580	0.5	0.53	106
295, 367, 415, 481	0.5	0.52	104
301, 335, 373	0.5	0.47	94
283, 288, 337	0.5	0.55	110
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.49	98
505, 523, 614	0.5	0.43	86
608, 666, 644, 662, 650, 664	0.5	0.44	88
606, 620, 626, 630, 656, 668, 674	0.5	0.48	96
728, 740, 746	0.5	0.51	102
628, 734, 836, 854, 856, 860	0.5	0.44	88
686, 788, 842	0.5	0.45	90
596, 632, 638	0.5	0.48	96
680, 698, 716, 718, 722, 830, 858	0.5	0.49	98
770, 782, 908	0.5	0.48	96
692, 710, 818	0.5	0.44	88
704, 764, 800	0.5	0.48	96
720, 806, 878, 914, 920, 922, 932	0.5	0.48	96

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 7. Continuing quality control data for the Summer 1991 San Joaquin River study,

Screen: Organophosphate	UCL = 119	Sample Type: Surface Water
Analyte: Diazinon OA	UWL = 112	Lab: CDFA
MDL: 0.2 ppb	LWL= 83	Chemist: Jean Hsu
	LCL= 76	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.45	90
349, 403, 559, 580	0.5	0.48	96
295, 367, 415, 481	0.5	0.44	88
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.51	IO2
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.45	90
505, 523, 614	0.5	0.52	104
608, 666, 644, 662, 650, 664	0.5	0.48	96
606, 620, 626, 630, 656, 668, 674	0.5	0.44	88
728, 740, 746	0.5	0.44	88
628, 734, 836, 854, 856, 860	0.5	0.46	92
686, 788, 842	0.5	0.44	88
596, 632, 638	0.5	0.54	108
680, 698, 716, 718, 722, 830, 858	0.5	0.42	84
770, 782, 908	0.5	0.48	96
692, 710, 818	0.5	0.46	92
704, 764, 800	0.5	0.46	92
720, 806, 878, 914, 920, 922, 932	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 8. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 116	Sample Type: Surface Water
Analyte: Dimethoate	UWL = 110	Lab: CDFA
MDL: 0.05 ppb	LWL= 86	Chemist: Jean Hsu
	LCL= 80	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.47	94
349, 403, 559, 580	0.5	0.46	92
295, 367, 415, 481	0.5	0.48	96
301, 335, 373	0.5	0.48	96
283, 288, 337	0.5	0.48	96
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.49	98
505, 523, 614	0.5	0.49	98
608, 666, 644, 662, 650, 664	0.5	0.45	90
606, 620, 626, 630, 656, 668, 674	0.5	0.54	108
728, 740, 746	0.5	0.48	96
628, 734, 836, 854, 856, 860	0.5	0.49	98
686, 788, 842	0.5	0.49	98
596, 632, 638	0.5	0.56	112
680, 698, 716, 718, 722, 830, 858	0.5	0.45	90
770, 782, 908	0.5	0.47	94
692, 710, 818	0.5	0.46	92
704, 764, 800	0.5	0.51	102
720, 806, 878, 914, 920, 922, 932	0.5	0.43	86

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 9. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 108		Sample Type: Surface Water
Analyte: Ethyl Parathion	UWL = 104		Lab: CDFA
MDL: 0.05 ppb	LWL= 89		Chemist: Jean Hsu
	LCL = 86		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.51	102
349, 403, 559, 580	0.5	0.45	90
295, 367, 415, 481	0.5	0.44	88
301, 335, 373	0.5	0.43	86
283, 288, 337	0.5	0.43	86
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.50	100
505, 523, 614	0.5	0.48	96
608, 666, 644, 662, 650, 664	0.5	0.48	96
606, 620, 626, 630, 656, 668, 674	0.5	0.44	88
728, 740, 746	0.5	0.48	96
628, 734, 836, 854, 856, 860	0.5	0.49	98
686, 788, 842	0.5	0.44	88
596, 632, 638	0.5	0.46	92
680, 698, 716, 718, 722, 830, 858	0.5	0.44	88
770, 782, 908	0.5	0.47	94
692, 710, 818	0.5	0.47	94
704, 764, 800	0.5	0.47	94
720, 806, 878, 914, 920, 922, 932	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 10. Continuing quality control data for the Summer 1991 San Joaquin River study,

Screen: Organophosphate	UCL = 113		Sample Type: Surface Water
Analyte: Ethyl Parathion OA	UWL = 107		Lab: CDFA
MDL: 0.20 ppb	LWL= 83		Chemist: Jean Hsu
	LCL = 77		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.42	84
349, 403, 559, 580	0.5	0.48	96
295, 367, 415, 481	0.5	0.47	94
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.47	94
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.48	96
505, 523, 614	0.5	0.43	86
608, 666, 644, 662, 650, 664	0.5	0.45	90
606, 620, 626, 630, 656, 668, 674	0.5	0.45	90
728, 740, 746	0.5	0.45	90
628, 734, 836, 854, 856, 860	0.5	0.47	94
686, 788, 842	0.5	0.46	92
596, 632, 638	0.5	0.47	94
680, 698, 716, 718, 722, 830, 858	0.5	0.45	90
770, 782, 908	0.5	0.51	102
692, 710, 818	0.5	0.46	92
704, 764, 800	0.5	0.44	88
720, 806, 878, 914, 920, 922, 932	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 11. Continuing quality control data for the Summer 199 1 San Joaquin River study.			
Screen: Organophosphate Analyte: Malathion MDL: 0.05 ppb	UCL = 114 uwL= 109 LWL= 87 LCL= 81	Sample Type: Surface Water Lab: CDFA Chemist: Jean Hsu	
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
573	1.0	1.03	103
343, 348, 487, 579	0.5	0.47	94
349, 403, 559, 580	0.5	0.50	100
295, 367, 415, 481	0.5	0.53	166
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.51	102
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.52	104
505, 523, 614	0.5	0.48	96
608, 666, 644, 662, 650, 664	0.5	0.44	88
606, 620, 626, 630, 656, 668, 674	0.5	0.51	102
728, 740, 746	0.5	0.48	96
628, 734, 836, 854, 856, 860	0.5	0.46	92
686, 788, 842	0.5	0.44	88
596, 632, 638	0.5	0.50	100
680, 698, 716, 718, 722, 830, 858	0.5	0.54	108
770, 782, 908	0.5	0.46	92
692, 710, 818	0.5	0.47	94
704, 764, 800	0.5	0.51	102
720, 806, 878, 914, 920, 922, 932	0.5	0.48	96

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 12. Continuing quality control data for the Summer 1991 San Joaquin River study.			
Screen: Organophosphate Malathion OA MDL: 0.2 ppb	UCL= 124 uwL= 117 LWL = 88 LCL= 80	Sample Type: Surface Water Lab: CDFA Chemist: Jean Hsu	
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.50	100
349, 403, 559, 580	0.5	0.53	106
295, 367, 415, 481	0.5	0.47	94
301, 335, 373	0.5	0.52	104
283, 288, 337	0.5	0.51	102
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.53	106
505, 523, 614	0.5	0.51	102
608, 666, 644, 662, 650, 664	0.5	0.52	104
606, 620, 626, 630, 656, 668, 674	0.5	0.48	96
728, 740, 746	0.5	0.49	98
628, 734, 836, 854, 856, 860	0.5	0.45	90
686, 788, 842	0.5	0.48	96
596, 632, 638	0.5	0.52	104
680, 698, 716, 718, 722, 830, 858	0.5	0.47	94
770, 782, 908	0.5	0.51	102
692, 710, 818	0.5	0.50	100
704, 764, 800	0.5	0.50	100
720, 806, 878, 914, 920, 922, 932	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 13. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 124	Sample Type: Surface Water
Analyte: Methidathion	UWL= 116	Lab: CDFA
MDL: 0.10 ppb	LWL= 83	Chemist: Jean Hsu
	LCL = 75	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.49	98
349, 403, 559, 580	0.5	0.50	100
295, 367, 415, 481	0.5	0.52	104
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.46	92
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.50	100
505, 523, 614	0.5	0.48	96
608, 666, 644, 662, 650, 664	0.5	0.50	100
606, 620, 626, 630, 656, 668, 674	0.5	0.53	106
728, 740, 746	0.5	0.49	98
628, 734, 836, 854, 856, 860	0.5	0.48	96
686, 788, 842	0.5	0.45	90
5969632,638	0.5	0.52	104
680, 698, 716, 718, 722, 830, 858	0.5	0.52	104
770, 782, 908	0.5	0.47	94
692, 710, 818	0.5	0.50	100
704, 764, 800	0.5	0.51	102
720, 806, 878, 914, 920, 922, 932	0.5	0.51	102

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 14. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL = 117	Sample Type: Surface Water
Analyte: Methidathion OA	uwL= 111	Lab: CDFA
MDL: 0.50 ppb	LWL= 85	Chemist: Jean Hsu
	LCL= 78	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.48	96
349, 403, 559, 580	1.0	1.00	100
295, 367, 415, 481	0.5	0.43	86
301, 335, 373	0.5	0.55	110
283, 288, 337	0.5	0.51	102
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.46	92
505, 523, 614	0.5	0.50	100
608, 666, 644, 662, 650, 664	0.5	0.54	108
606, 620, 626, 630, 656, 668, 674	0.5	0.54	108
728, 740, 746	0.5	0.54	108
628, 734, 836, 854, 856, 860	0.5	0.51	102
686, 788, 842	0.5	0.51	102
596, 632, 638	0.5	0.50	100
680, 698, 716, 718, 722, 830, 858	0.5	0.44	88
770, 782, 908	0.5	0.54	108
692, 710, 818	0.5	0.50	100
704, 764, 800	0.5	0.54	108
720, 806, 878, 914, 920, 922, 932	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 15. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate
Analyte: Methyl Parathion
MDL: 0.05 ppb

UCL= 116
uwL= 110
LWL = 85
LCL = 79

Sample Type: Surface Water
Lab: CDFA
Chemist: Jean Hsu

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.52	104
349, 403, 559, 580	0.5	0.49	98
295, 367, 415, 481	0.5	0.51	102
301, 335, 373	0.5	0.45	90
283, 288, 337	0.5	0.50	100
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.54	108
505, 523, 614	0.5	0.44	88
608, 666, 644, 662, 650, 664	0.5	0.46	92
606, 620, 626, 630, 656, 668, 674	0.5	0.51	102
728, 740, 746	0.5	0.48	96
628, 734, 836, 854, 856, 860	0.5	0.45	90
686, 788, 842	0.5	0.46	92
596, 632, 638	0.5	0.49	98
680, 698, 716, 718, 722, 830, 858	0.5	0.52	104
770, 782, 908	0.5	0.48	96
692, 710, 818	0.5	0.48	96
704, 764, 800	0.5	0.52	104
720, 806, 878, 914, 920, 922, 932	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 16. Continuing quality control data for the Summer 1991 San Joaquin River study,

Screen: Organophosphate
Analyte: Methyl Parathion OA
MDL: 0.2 ppb

Sample Type: Surface Water
Lab: CDFA
Chemist: Jean Hsu

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.43	86
349, 403, 559, 580	0.5	0.44	88
295, 367, 415, 481	0.5	0.44	88
301, 335, 373	0.5	0.46	92
283, 288, 337	0.5	0.48	96
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.50	100
505, 523, 614	0.5	0.44	88
608, 666, 644, 662, 650, 664	0.5	0.49	98
606, 620, 626, 630, 656, 668, 674	0.5	0.45	90
728, 740, 746	0.5	0.49	98
628, 734, 836, 854, 856, 860	0.5	0.47	94
686, 788, 842	0.5	0.50	100
596, 632, 638	0.5	0.52	104
680, 698, 716, 718, 722, 830, 858	0.5	0.44	88
770, 782, 908	0.5	0.47	94
692, 710, 818	0.5	0.43	86
704, 764, 800	0.5	0.50	100
720, 806, 878, 914, 920, 922, 932	0.5	0.55	110

UCL = upper-control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

Table 17. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 125		Sample Type: Surface Water
Analyte: Phosalone	UWL = 117		Lab: CDFA
MDL: 0.10 ppb	LWL= 87		Chemist: Jean Hsu
	LCL = 79		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.48	96
349, 403, 559, 580	0.5	0.51	102
295, 367, 415, 481	0.5	0.51	102
301, 335, 373	0.5	0.51	102
283, 288, 337	0.5	0.49	98
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.53	106
505, 523, 614	0.5	0.52	104
608, 666, 644, 662, 650, 664	0.5	0.52	104
606, 620, 626, 630, 656, 668, 674	0.5	0.46	92
728, 740, 746	0.5	0.51	102
628, 734, 836, 854, 856, 860	0.5	0.48	96
686, 788, 842	0.5	0.51	102
596, 632, 638	0.5	0.42	84
680, 698, 716, 718, 722, 830, 858	0.5	0.46	92
770, 782, 908	0.5	0.50	100
692, 710, 818	0.5	0.47	94
704, 764, 800	0.5	0.52	104
720, 806, 878, 914, 920, 922, 932	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 18. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL = 129		Sample Type: Surface Water
Analyte: Phosalone OA	uwL= 121		Lab: CDFA
MDL: 0.20 ppb	LWL= 85		Chemist: Jean Hsu
	LCL = 77		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.48	96
349, 403, 559, 580	0.5	0.48	96
295, 367, 415, 481	0.5	0.49	98
301, 335, 373	0.5	0.51	102
283, 288, 337	0.5	0.53	106
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.46	92
505, 523, 614	0.5	0.57	114
608, 666, 644, 662, 650, 664	0.5	0.49	98
606, 620, 626, 630, 656, 668, 674	0.5	0.53	106
728, 740, 746	0.5	0.50	100
628, 734, 836, 854, 856, 860	0.5	0.42	84
686, 788, 842	0.5	0.53	106
596, 632, 638	0.5	0.51	102
680, 698, 716, 718, 722, 830, 858	0.5	0.50	100
770, 782, 908	0.5	0.40	80
692, 710, 818	0.5	0.53	106
704, 764, 800	0.5	0.53	106
720, 806, 878, 914, 920, 922, 932	0.5	0.54	108

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 19. Continuing **quality** control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 118		Sample Type: Surface Water
Analyte: Phosmet	uwL= 113		Lab: CDFA
MDL: 0.10 ppb	LWL = 95		Chemist: Jean Hsu
	LCL = 90		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.54	108
349, 403, 559, 580	0.5	0.51	102
295, 367, 415, 481	0.5	0.51	102
301, 335, 373	0.5	0.56	112
283, 288, 337	0.5	0.49	98
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.44	**88***
505, 523, 614	0.5	0.42	**84***
608, 666, 644, 662, 650, 664	0.5	0.58	116
606, 620, 626, 630, 656, 668, 674	0.5	0.53	106
728, 740, 746	0.5	0.56	112
628, 734, 836, 854, 856, 860	0.5	0.50	100
686, 788, 842	0.5	0.55	110
596, 632, 638	0.5	0.47	94
680, 698, 716, 718, 722, 830, 858	0.5	0.46	92
770, 782, 908	0.5	0.57	114
692, 710, 818	0.5	0.47	94
704, 764, 800	0.5	0.53	106
720, 806, 878, 914, 920, 922, 932	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

* Matrix spike recovery fell below the lower control limit.

Table 20. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Organophosphate	UCL= 124		Sample Type: Surface Water
Analyte: Phosmet OA	UWL = 115		Lab: CDFA
MDL: 0.50 ppb	LWL= 79		Chemist: Jean Hsu
	LCL = 70		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
343, 348, 487, 579	0.5	0.52	104
349, 403, 559, 580	0.5	0.55	110
295, 367, 415, 481	0.5	0.46	92
301, 335, 373	0.5	0.52	104
283, 288, 337	0.5	0.57	114
289, 333, 335, 342, 361, 464, 469, 584	0.5	0.50	100
505, 523, 614	0.5	0.56	112
608, 666, 644, 662, 650, 664	0.5	0.41	82
606, 620, 626, 630, 656, 668, 674	0.5	0.54	108
728, 740, 746	0.5	0.50	100
686, 788, 842	0.5	0.56	1 1 2
596, 632, 638	0.5	0.62	124
680, 698, 716, 718, 722, 830, 858	0.5	0.55	110
770, 782, 908	0.5	0.42	84
692, 710, 818	0.5	0.52	104
704, 764, 800	0.5	0.53	106
720, 806, 878, 914, 920, 922, 932	0.5	0.56	112

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 1. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 117		Sample Type: Surface Water
Analyte: Azinphos-methyl	uWL= 111		Lab: CDFA
MDL: 0.05 ppb	LWL= 87		Chemist: J. White
	LCL = 81		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.47	94
1786, 1816, 1849	0.5	0.54	108
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.42	84
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.49	98
1406, 1430, 1485, 1671	0.5	0.58	116
1165, 1750, 1756	0.5	0.58	116
1189, 1762, 1768, 1869	0.5	0.49	98
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.47	94
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.44	88
1400, 1479, 1647, 1720	0.5	0.46	92
1497, 1605, 1696, 1773	0.5	0.52	104
1509, 1570, 1714, 1726	0.5	0.55	110

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 2. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 114		Sample Type: Surface Water
Analyte: Azinphos-methyl OA	. UWL = 108		Lab: CDFA
MDL: 0.05 ppb	LWL = 84		Chemist: J. White
	LCL = 78		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, 1816, 1849	0.5	0.48	96
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.40	80
1165, 1750, 1756	0.5	0.57	114
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.48	96

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

Table 3. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL= 116		Sample Type: Surface Water
Analyte: Chlorpyrifos	UWL = 110		Lab: CDFA
MDL: 0.05 ppb	LWL = 83		Chemist: J. White
	LWL = 76		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.47	94
1786, 1816, 1849	0.5	0.51	102
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.53	106
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.56	112
1406, 1430, 1485, 1671	0.5	0.50	100
1165, 1750, 1756	0.5	0.51	102
1189, 1762, 1768, 1869	0.5	0.54	108
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.47	94
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.48	96
1400, 1479, 1647, 1720	0.5	0.52	104
1497, 1605, 1696, 1773	0.5	0.54	108
1509, 1570, 1714, 1726	0.5	0.55	110

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 4. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 121		Sample Type: Surface Water
Analyte: Chlorpyrifos OA	uWL= 113		Lab: CDFA
MDL: 0.05 ppb	LWL = 80		Chemist: J. White
	LCL = 72		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, 1816, 1849	0.5	0.59	118
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.45	90
1165, 1750, 1756	0.5	0.54	108
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 5. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 123		Sample Type: Surface Water
Analyte: DDVP	uwL= 115		Lab: CDFA
MDL: 0.05 ppb	LWL-81		Chemist: J. White
	LCL = 73		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.48	96
1786, 1816, 1849	0.5	0.50	100
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.51	102
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.53	106
1406, 1430, 1485, 1671	0.5	0.50	100
1165, 1750, 1756	0.5	0.50	100
105-1189, 1762, 1768, 1869	0.5	0.52	104
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.45	90
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.52	104
1400, 1479, 1647, 1720	0.5	0.48	96
1497, 1605, 1696, 1773	0.5	0.50	100
1509, 1570, 1714, 1726	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 6. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL =122		Sample Type: Surface Water
Analyte: Diazinon	UWL = 113		Lab: CDFA
MDL: 0.05 ppb	LWL = 78		Chemist: J. White
	LCL = 69		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.48	96
1786, 1816, 1849	0.5	0.51	102
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.51	102
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.54	108
1406, 1430, 1485, 1671	0.5	0.51	102
1165, 1750, 1756	0.5	0.52	104
105-1189, 1762, 1768, 1869	0.5	0.54	108
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.49	98
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.48	96
1400, 1479, 1647, 1720	0.5	0.51	102
1497, 1605, 1696, 1773	0.5	0.54	108
1509, 1570, 1714, 1726	0.5	0.53	106

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 7. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 119		Sample Type: Surface Water
Analyte: Diazinon OA	uWL= 112		Lab: CDFA
MDL: 0.05 ppb	LWL = 83		Chemist: J. White
	LCL = 76		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, 1792, 1798, 1828	0.5	0.50	100
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.52	104
1406, 1430, 1485, 1671	0.5	0.45	90
1189, 1762, 1768, 1869	0.5	0.48	96
1400, 1479, 1647, 1720	0.5	0.46	92

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 8. Continuing quality control data for the Summer 1992 San Joaquin River study,

Screen: Organophosphate	UCL= 116		Sample Type: Surface Water
Analyte: Dimethoate	UWL = 110		Lab: CDFA
MDL: 0.05 ppb	LWL = 86		Chemist: J. White
	LCL = 80		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.49	98
1786, 1816, 1849	0.5	0.50	100
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.47	94
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.55	110
1406, 1430, 1485, 1671	0.5	0.50	100
1165, 1750, 1756	0.5	0.49	98
1189, 1762, 1768, 1869	0.5	0.54	108
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.44	88
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.51	102
1400, 1479, 1647, 1720	0.5	0.52	104
1497, 1605, 1696, 1773	0.5	0.52	104
1509, 1570, 1714, 1726	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 9. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 105		Sample Type: Surface Water
Analyte: Ethoprop	UWL = 103		Lab: CDFA
MDL: 0.05 ppb	LWL = 93		Chemist: J. White
	LCL = 91		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.50	100
1774, 1792, 1798, 1828	0.5	0.49	98
1161, 1782, 1812, 1833, 1839, 1845, 1857, 1863	0.5	0.47	94
1704, 1740, 1746, 1824	0.5	0.49	98
1396, 1408, 1432, 1487, 1493, 1673, 1710, 1742	0.5	0.46	92
1167, 1752, 1758	0.5	0.44	88
1497, 1605, 1696, 1773	0.5	0.52	104
1788, 1818, 1851	0.5	0.51	102
2354, 1414, 1420, 1426	0.4	0.31	**78***

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

* Matrix spike recovery fell below the lower control limit.

Table 10. Continuing quality control data for the Summer 1992 San Joaquin River study,

Screen: Organophosphate	UCL = 108		Sample Type: Surface Water
Analyte: Ethyl Parathion	UWL = 104		Lab: CDFA
MDL: 0.05 ppb	LWL = 89		Chemist: J. White
	LCL = 86		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, 1792, 1798, 1828	0.5	0.46	92
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.52	104
1406, 1430, 1485, 1671	0.5	0.46	92
1189, 1762, 1768, 1869	0.5	0.47	94
1400, 1479, 1647, 1720	0.5	0.46	92

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 11. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 113		Sample Type: Surface Water
Analyte: Ethyl Parathion OA	UWL = 107		Lab: CDFA
MDL: 0.05 ppb	LWL = 83		Chemist: J. White
	LCL = 77		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, **1816, 1849**	0.5	0.42	84
1394, **1491, 1702,** 1708, 1738, 1744, 1822	0.5	0.51	102
1165, **1750, 1756**	0.5	0.54	108
1443, 1551, 1629, 1732, **1449, 1665, 1690**	0.5	0.53	106

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 12. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 102		Sample Type: Surface Water
Analyte: Fonofos	UWL = 100		Lab: CDFA
MDL: 0.05 ppb	LWL = 94		Chemist: J. White
	LCL = 92		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.50	0.49	98
1774, 1 1798, 182 **1792,**	0.5	0.50	100
1161, 178[illegible], 1812, 183 178[illegible] 1839, 1845, 1857, 1863	0.5	0.45	**90***
1704, **1740, 1746,** 1824	0.5	0.46	92
1396, 1408, 1432, 1487, 1493, 1673, 1710, 1742	0.5	0.44	**88***
1167, 1752, 1758	0.5	0.44	**88***
1497, 1605, 1696, 1773	0.5	0.50	100
1788, 1818, 1851	0.5	0.49	98
2354, 1414, 1420, 1426	0.4	0.33	**83***

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

* Matrix spike recovery fell below the lower control limit.

Table 13. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 114	"Sample Type: Surface Water
Analyte: Malathion	uWL= 109	Lab: CDFA
MDL: 0.05 ppb	LWL = 87	Chemist: J. White
	LCL = 81	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.50	100
1786, 1816, 1849	0.5	0.52	104
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.50	100
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.54	108
1406, 1430, 1485, 1671	0.5	0.52	104
1165, 1750, 1756	0.5	0.52	104
1189, 1762, 1768, 1869	0.5	0.56	112
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.47	94
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.46	92
1400, 1479, 1647, 1720	0.5	0.53	106
1497, 1605, 1696, 1773	0.5	0.54	108
1509, 1570, 1714, 1726	0.5	0.55	110

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 14. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 124	Sample Type: Surface Water
Analyte: Malathion OA	UWL = 117	Lab: CDFA
MDL: 0.05 ppb	LWL = 88	Chemist: J. White
	LCL = 80	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, 1792, 1798, 1828	0.5	0.50	100
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.52	104
1406, 1430, 1485, 1671	0.5	0.43	86
1189, 1762, 1768, 1869	0.5	0.46	92
1400, 1479, 1647, 1720	0.5	0.47	94

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 15. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 124	Sample Type: Surface Water
Analyte: Methidathion	UWL= 116	Lab: CDFA
MDL: 0.05 ppb	LWL = 83	Chemist: J. White
	LCL = 75	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.48	96
1786, 1816, 1849	0.5	0.52	104
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.50	100
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.54	108
1406, 1430, 1485, 1671	0.5	0.53	106
1165, 1750, 1756	0.5	0.54	108
105-1189, 1762, 1768, 1869	0.5	0.56	112
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.48	96
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.50	100
1400, 1479, 1647, 1720	0.5	0.53	106
1497, 1605, 1696, 1773	0.5	0.50	100
1509, 1570, 1714, 1726	0.5	0.53	106

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 16. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Organophosphate Analyte: Methidathion OA MDL: 0.05 ppb	UCL = 117 UWL = 111 LWL = 85 LCL = 78		Sample Type: Surface Water Lab: CDFA Chemist: J. White
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, **1816, 1849**	0.5	0.55	110
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.45	90
1165, **1750, 1756**	0.5	0.55	110
1443, **1551, 1629, 1732,** 1449, 1665, 1690	0.5	0.55	110
1629, 1732, 1449, 1665, 1690	0.5	0.55	110

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

Table 17. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Organophosphate **Analyte:** Methyl Parathion MDL: 0.05 ppb	UCL= 116 UWL = 110 LWL = 85 LCL = 79		Sample Type: Surface Water Lab: CDFA Chemist: J. White
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, 1424, 2352	0.5	0.48	96
1786, **1816, 1849**	0.5	0.51	102
1159, 1780, **1810, 1831**, 1837, 1843, 1855, 1861, 1867	0.5	0.48	96
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.54	108
1406, 1430, 1485, 1671	0.5	0.52	104
1165, 1750, 1756	0.5	0.49	98
1189, **1762, 1768, 1869**	0.5	0.54	108
1177, 1563, **1635, 1872, 1611, 1653, 1677,** 1641	0.5	0.49	98
1443, **1551, 1629, 1732,** 1449, **1665, 1690**	0.5	0.46	92
1400, 1479, 1647, 1720	0.5	0.51	102
1497, **1605, 1696,** 1773	0.5	0.54	108
1509, 1570, 1714, 1726	0.5	0.54	108

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 18. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Organophosphate Analyte: Methyl Parathion OA MDL: 0.05 ppb	UCL = 120 UWL = 112 LWL = 79 LCL = 71		Sample Type: Surface Water Lab: CDFA Chemist: J. White
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, 1816, 1849	0.5	0.48	96
1394, 1491, 1702, 1708, **1738, 1744, 1822**	0.5	0.48	96
1165, 1750, 1756	0.5	0.54	108
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.53	106

UCL = upper control limit, UWL = upper **warning** limit, LWL = lower warning limit, LCL = lower control limit.

Table 19. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 110		Sample Type: Surface Water
Analyte: Phorate	UWL = 104		Lab: CDFA
MDL: 0.05 ppb	LWL = 80		Chemist: J. White
	LCL = 74		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1786, 1816, 1849	0.5	0.40	80
1394, 1491, 1702, 1708, 1738, 1744, 1822	0.5	0.51	102
1165, 1750, 1756	0.5	0.52	104
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 20. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 125		Sample Type: Surface Water
Analyte: Phosalone	UWL = 117		Lab: CDFA
MDL: 0.05 ppb	LWL = 87		Chemist: J. White
	LCL = 79		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, 1792, 1798, 1828	0.5	0.47	94
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.53	106
1406, 1430, 1485, 1671	0.5	0.49	98
1189, 1762, 1768, 1869	0.5	0.49	98
1400, 1479, 1647, 1720	0.5	0.46	92

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 2 1. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Organophosphate	UCL = 129		Sample Type: Surface Water
Analyte: Phosalone OA	UWL = 121		Lab: CDFA
MDL: 0.05 ppb	LWL = 85		Chemist: J. White
	LCL = 77		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, 1792, 1798, 1828	0.5	0.53	106
1159, 1780, 1810, 1831, 1837, 1843, 1855, 1861, 1867	0.5	0.52	104
1406, 1430, 1485, 1671	0.5	0.43	86
1189, 1762, 1768, 1869	0.5	0.46	92
1400, 1479, 1647, 1720	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 22. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Organophosphate	UCL = 118		Sample Type: Surface Water
Analyte: Phosmet	UWL = 113		Lab: CDFA
MDL: 0.05 ppb	LWL = 95		Chemist: J. White
	LCL = 90		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1412, 1418, **1424, 2352**	0.5	0.52	104
1786, **1816, 1849**	0.5	0.51	102
1159, **1780, 1810,** 1831, **1837, 1843,** 1855, **1861, 1867**	0.5	0.44	**88***
1394, **1491, 1702,** 1708, 1738, 1744, 1822	0.5	0.53	106
1406, **1430, 1485,** 1671	0.5	0.52	104
1165, 1750, 1756	0.5	0.51	102
1189, **1762, 1768,** 1869	0.5	0.57	114
1177, 1563, 1635, 1872, 1611, 1653, 1677, 1641	0.5	0.46	92
1443, 1551, 1629, 1732, 1449, 1665, 1690	0.5	0.48	96
1400, 1479, 1647, 1720	0.5	0.46	92
1497, 1605, 1696, 1773	0 . 5	0.52	104
1509, 1570, 1714, 1726	0.5	0.58	116

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

* Matrix spike recovery fell below the lower control limit

Table 23. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Organophosphate	UCL = 124		Sample Type: Surface Water
Analyte: Phosmet OA	uWL= 115		Lab: CDFA
MDL: 0.05 ppb	LWL = 79		Chemist: J. White
	LCL = 70		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1774, **1792, 1798,** 1828	0.5	0.60	120
1159, **1780, 1810,** 1831, **1837, 1843,** 1855, 1861, 1867	0.5	0.50	100
1406, **1430, 1485,** 1671	0.5	0.36	72
1189, **1762, 1768,** 1869	0.5	0.43	86
1400, 1479, 1647, 1720	0.5	0.48	96

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 1. Continuing quality control data for the Summer 1991 San Joaquin River study.			
Screen: Carbamate	UCL = 117	Sample Type: Surface Water	
Analyte: Aldicarb	UWL = 109	Lab: CDFA	
MDL: 0.05 ppb	LWL= 76	Chemist: Sylvia Richman	
	LCL = 6 8		
Sample Analyzed with Each Extraction Set (Sample Number)	**Spike Level (ppb)**	**Results (ppb)**	**Recovery %**
344, 488, 501, 576	0.5	0.45	90
350, 404, 560, 581	0.5	0.48	96
296, 368, 416, 482	0.5	0.48	96
302, 356, 374	0.5	0.49	98
284, 338, 411	0.5	0.48	96
506, 524, 615	0.5	0.41	82
290, 334, 336, 463, 465, 470, 585	0.5	0.46	92
609, 645, 651, 663, 665, 667	0.5	0.34	68
597, 633, 639	0.5	0.42	84
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.49	98
729, 741, 747	0.5	0.45	90
362, 629, 735, 837, 855, 857, 861	0.5	0.42	84
687, 789, 843	0.5	0.51	102
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.49	98
693, 711, 819	0.5	0.48	96
765, 705, 801	0.5	0.37	74
721, 879, 915, 933, 807, 921, 923	0.5	0.45	90

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 2. Continuing quality control data for the Summer 1991 San Joaquin River study.			
Screen: Carbamate	UCL = 87	Sample Type: Surface Water	
Analyte: Aldicarb sulfoxide	UWL = 81	Lab: CDFA	
MDL: 0.05 ppb	LWL = 57	Chemist: Sylvia Richman	
	LCL = 50		
Sample Analyzed with Each Extraction Set (Sample Number)	**Spike Level (ppb)**	**Results (ppb)**	**Recovery %**
350, 404, 560, 581	0.5	0.38	76
296, 368, 416, 482	0.5	0.47	94**
302, 356, 374	0.5	0.38	76
284, 338, 411	0.5	0.37	74
506, 524, 615	0.5	0.41	82
290, 334, 336, 463, 465, 470, 585	0.5	0.44	88**
609, 645, 651, 663, 665, 667	0.5	0.46	92**
597, 633, 639	0.5	0.34	68
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.43	86
729, 741, 747	0.5	0.37	74
362, 629, 735, 837, 855, 857, 861	0.5	0.39	78
687, 789, 843	0.5	0.44	88**
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.41	82
693, 711, 819	0.5	0.41	82
765, 705, 801	0.5	0.35	70
721, 879, 915, 933, 807, 921, 923	0.5	0.42	84

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

** Matrix spike recovery fell above the upper control limit.

Table 3. Continuing quality control data for the Summer 1991 San Joaquin River study,

Screen: Carbamate	UCL= 116	Sample Type: Surface Water
Analyte: Aldicarb sulfone	uWL= 111	Lab: CDFA
MDL: 0.05 ppb	LWL = 88	Chemist: Sylvia Richman
	LCL= 82	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.36	72
350, 404, 560, 581	0.5	0.49	98
296, 368, 416, 482	0.5	0.42	84
302, 356, 374	0.5	0.49	98
284, 338, 411	0.5	0.43	86
506, 524, 615	0.5	0.50	100
290, 334, 336, 463, 465, 470, 585	0.5	0.57	114
609, 645, 651, 663, 665, 667	0.5	0.50	100
597, 633, 639	0.5	0.52	104
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.47	94
729, 74 1,747	0.5	0.41	82
362, 629, 735, 837, 855, 857, 861	0.5	0.52	104
687, 789, 843	0.5	0.53	106
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.45	90
693, 711, 819	0.5	0.50	100
765, 705, 801	0.5	0.48	96
721, 879, 915, 933, 807, 921, 923	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 4. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate	UCL= 124	Sample Type: Surface Water
Analyte: Carbaryl	UWL = 116	Lab: CDFA
MDL: 0.05 ppb	LWL= 83	Chemist: Sylvia Richman
	LCL = 75	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.53	106
350; 404, 560, 581	0.5	0.51	102
296, 368, 416, 482	0.5	0.46	92
302, 356, 374	0.5	0.48	96
284, 338, 411	0.5	0.49	98
506, 524, 615	0.5	0.50	100
290, 334, 336, 463, 465, 470, 585	0.5	0.55	110
609, 645, 651, 663, 665, 667	0.5	0.47	9 4
597, 633, 639	0.5	0.45	90
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.50	100
7295741,747	0.5	0.50	100
362, 629, 735, 837, 855, 857, 861	0.5	0.44	88
687, 789, 843	0.5	0.53	106
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.51	102
693, 711, 819	0.5	0.52	104
765, 705, 801	0.5	0.45	90
721, 879, 915, 933, 807, 921, 923	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 5. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate
Analyte: Carbofuran
MDL: 0.05 ppb

UCL = 113
UWL = 108
LWL = 89
LCL= 84

Sample Type: Surface Water
Lab: CDFA
Chemist: Sylvia Richman

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.50	100
350, 404, 560, 581	0.5	0.48	96
296, 368, 416, 482	0.5	0.42	84
302, 356, 374	0.5	0.50	100
284,338,. 411	0.5	0.47	94
506, 524, 615	0.5	0.50	100
290, 334, 336, 463, 465, 470, 585	0.5	0.54	108
609, 645, 651, 663, 665, 667	0.5	0.50	100
597, 633, 639	0.5	0.55	110
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.47	94
729, 741, 747	0.5	0.47	94
362, 629, 735, 837, 855, 857, 861	0.5	0.45	90
687, 789, 843	0.5	0.53	106
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.48	96
693, 711, 819	0.5	0.48	96
765, 705, 801	0.5	0.51	102
721, 879, 915, 933, 807, 921, 923	0.5	0.49	98

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,

Table 6. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate
Analyte: 3-Hydroxy Carbofuran
MDL: 0.05 ppb

UCL= 126
UWL = 117
LWL= 82
LCL = 73

Sample Type: Surface Water
Lab: CDFA
Chemist: Sylvia Richman

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
350, 404, 560, 581	0.5	0.51	102
296, 368, 416, 482	0.5	0.41	82
302, 356, 374	0.5	0.47	94
284, 338, 411	0.5	0.43	86
506, 524, 615	0.5	0.50	100
290, 334, 336, 463, 465, 470, 585	0.5	0.54	108
609, 645, 651, 663, 665, 667	0.5	0.49	98
597, 633, 639	0.5	0.53	106
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.48	96
729, 741, 747	0.5	0.45	90
362, 629, 735, 837, 855, 857, 861	0.5	0.46	92
687, 789, 843	0.5	0.54	108
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.46	92
693, 711, 819	0.5	0.49	98
765, 705, 801	0.5	0.48	96
721, 879, 915, 933, 807, 921, 923	0.5	0.51	102

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 7. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate
Analyte: Methiocarb
MDL: 0.05 ppb

UCL = 120
UWL = 113
LWL = 84
LCL= 76

-Sample Type: Surface Water
Lab: CDFA
Chemist: Sylvia Richman

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.52	104
350, 404, 560, 581	0.5	0.51	102
296, 368, 416, 482	0.5	0.45	90
302, 356, 374	0.5	0.47	94
284, 338, 411	0.5	0.48	96
506, 524, 615	0.5	0.51	102
290, 334, 336, 463, 465, 470, 585	0.5	0.54	108
609, 645, 651, 663, 665, 667	0.5	0.45	90
597, 633, 639	0.5	0.45	90
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.50	100
729, 741, 747	0.5	0.49	98
362, 629, 735, 837, 855, 857, 861	0.5	0.43	86
687, 789, 843	0.5	0.52	104
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.43	86
693, 711, 819	0.5	0.43	86
765, 705, 801	0.5	0.46	92
721, 879, 915, 933, 807, 921, 923	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 8. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate
Analyte: Methomyl
MDL: 0.05 ppb

UCL = 123
UWL = 114
LWL = 79
LCL = 70

Sample Type: Surface Water
Lab: CDFA
Chemist: Sylvia Richman

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.48	96
350, 404, 560, 581	0.5	0.47	94
296, 368, 416, 482	0.5	0.57	114
302, 356, 374	0.5	0.49	98
284, 338, 411	0.5	0.49	98
506, 524, 615	0.5	0.51	102
290, 334, 336, 463, 465, 470, 585	0.5	0.53	106
609, 645, 651, 663, 665, 667	0.5	0.50	100
597, 633, 639	0.5	0.52	104
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.45	90
729, 741, 747	0.5	0.43	86
362, 629, 735, 837, 855, 857, 861	0.5	0.50	100
687, 789, 843	0.5	0.46	92
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.45	90
693, 711, 819	0.5	0.47	94
765, 705, 801	0.5	0.48	96
721; 879, 915, 933, 807, 921, 923	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 9. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Carbamate	UCL = 130		Sample Type: Surface Water
Analyte: Oxamyl	UWL = 119		Lab: CDFA
MDL: 0.05 ppb	LWL= 77		Chemist: Sylvia Richman
	LCL = 66		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
344, 488, 501, 576	0.5	0.41	82
350, 404, 560, 581	0.5	0.49	98
296, 368, 416, 482	0.5	0.44	88
302, 356, 374	0.5	0.49	98
284, 338, 411	0.5	0.52	104
506, 524, 615	0.5	0.51	102
290, 334, 336, 463, 465, 470, 585	0.5	0.53	106
609, 645, 651, 663, 665, 667	0.5	0.50	100
597, 633, 639	0.5	0.49	98
607, 621, 627, 631, 657, 669, 675, 945, 952	0.5	0.49	98
729, 741, 747	0.5	0.50	100
362, 629, 735, 837, 855, 857, 861	0.5	0.47	94
687, 789, 843	0.5	0.54	108
681, 699, 717, 719, 723, 771, 783, 831, 859, 909	0.5	0.52	104
693, 711, 819	0.5	0.55	110
765, 705, 801	0.5	0.46	92
721, 879, 915, 933, 807, 921, 923	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 1. Continuing quality control data for the Summer 1992 San Joaquin River study,			
Screen: Carbamate Analyte: Aldicarb MDL: 0.05 ppb	UCL = 117 UWL = 109 LWL= 76 LCL = 68		'Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.075	75
1775, 1793, 1799, 1829	0.1	0.105	105
1787, 1817, 1850	0.1	0.096	96
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.081	81
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.079	79
1407,1431, 1486, 1672	0.1	0.073	73
1166, 1751, 1757	0.1	0.085	85
1190,1763, 1769, 1870	0.1	0.091	91
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.093	93
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.080	80
1401, 1480, 1648, 1721	0.1	0.087	87
1498, 1606, 1697	0.1	0.081	81
1510, 1571, 1715, 1727	0.1	0.091	91
1610, 1719, 1755	0.1	0.090	90

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 2. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Carbamate Analyte: Aldicarb SO MDL: 0.05 ppb	UCL = 87 UWL = 81 LWL = 57 LCL = 50		Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413,1419, 1425, 2353	0.1	0.077	77
1787, 1817, 1850	0.1	0.080	80
1160, 1781,1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.077	77
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.074	74
1407, 1431, 1486, 1672	0.1	0.072	72
1166, 1751, 1757	0.1	0.078	78
1190, 1763, 1769, 1870	0.1	0.087	87
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.072	72
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.081	81
1401, 1480, 1648, 1721	0.1	0.087	87
1498, 1606, 1697	0.1	0.080	80
1510, 1571, 1715, 1727	0.1	0.089	89**
1610, 1719, 1755	0.1	0.090	90**

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

** Matrix spike recovery fell above the upper control limit.

Table 3. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Carbamate	UCL = 116		"Sample Type: Surface Water	
Analyte: Aldicarb SO2	UWL = 110		Lab: CDFA	
MDL: 0.05 ppb	LWL = 88		Chemist: J. Hsu	
	LCL= 82			

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.090	90
1775, 1793, 1799, 1829	0.1	0.095	95
1787, 1817, 1850	0.1	0.097	97
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.092	92
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.091	91
1407, 1431, 1486, 1672	0.1	0.097	97
1166, 1751, 1757	0.1	0.110	110
1190, 1763, 1769, 1870	0.1	0.084	84
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.091	91
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.077	77*
1401, 1480, 1648, 1721	0.1	0.090	90
1498, 1606, 1697	0.1	0.102	102
1510, 1571, 1715, 1727	0.1	0.085	85
1610, 1719, 1755	0.1	0.109	109

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit,
* Matrix spike recovery fell below the lower control limit.

Table 4. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Carbamate	UCL= 124		Sample Type: Surface Water	
Analyte: Carbaryl	UWL = 116		Lab: CDFA	
MDL: 0.05 ppb	LWL= 83		Chemist: J. Hsu	
	LCL = 75			

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.100	100
1775, 1793, 1799, 1829	0.1	0.097	97
1787, 1817, 1850	0.1	0.109	109
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.091	91
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.095	95
1407, 1431, 1486, 1672	0.1	0.090	90
1166, 1751, 1757	0.1	0.111	111
1190, 1763, 1769, 1870	0.1	0.098	98
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.087	87
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.084	84
1401, 1480, 1648, 1721	0.1	0.089	89
1498, 1606, 1697	0.1	0.085	85
1510, 1571, 1715, 1727	0.1	0.090	90
1610, 1719, 1755	0.1	0.090	90

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 5. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Carbamate Analyte: Carbofuran MDL: 0.05 ppb	UCL = 113 UWL = 108 LWL= 89 LCL= 84		Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.092	92
1775, 1793, 1799, 1829	0.1	0.087	87
1787, 1817, 1850	0.1	0.091	91
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.092	92
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.096	96
1407, 1431, 1486, 1672	0.1	0.091	91
1166, 1751, 1757	0.1	0.089	89
1190, 1763, 1769, 1870	0.1	0.086	86
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.095	95
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.088	88
1401, 1480, 1648, 1721	0.1	0.093	93
1498, 1606, 1697	0.1	0.102	102
1510, 1571, 1715, 1727	0.1	0.107	107
1610, 1719, 1755	0.1	0.106	106

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 6. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Carbamate Analyte: Carbofuran 3-OH MDL: 0.05 ppb	UCL = 126 UWL = 117 LWL = 83 LCL = 74		Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.086	86
1775, 1793, 1799, 1829	0.1	0.088	88
1787, 1817, 1850	0.1	0.093	93
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.090	90
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.101	101
1407, 1431, 1486, 1672	0.1	0.091	91
1166, 1751, 1757	0.1	0.088	88
1190, 1763, 1769, 1870	0.1	0.086	86
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.089	89
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.080	80
1401, 1480, 1648, 1721	0.1	0.092	92
1498, 1606, 1697	0.1	0.103	103
1510, 1571, 1715, 1727	0.1	0.089	89
1610, 1719, 1755	0.1	0.107	107

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 7. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Carbamate Analyte: Methiocarb MDL: 0.05 ppb	UCL = 120 UWL = 113 LWL = 83 LCL= 76		'Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.088	88
1775, 1793, 1799, 1829	0.1	0.089	89
1787, 1817, 1850	0.1	0.090	90
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.102	102
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.100	100
1407, 1431, 1486, 1672	0.1	0.101	101
1166, 1751, 1757	0.1	0.092	92
1190, 1763, 1769, 1870	0.1	0.085	85
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.086	86
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.086	86
1401, 1480, 1648, 1721	0.1	0.089	89
1498, 1606, 1697	0.1	0.109	109
1510, 1571, 1715, 1727	0.1	0.106	106
1610, 1719, 1755	0.1	0.102	102

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit

Table 8. Continuing quality control data for the Summer 1992 San Joaquin River study.			
Screen: Carbamate Analyte: Methomyl MDL: 0.05 ppb	UCL = 123 UWL = 114 LWL= 79 LCL = 70		Sample Type: Surface Water Lab: CDFA Chemist: J. Hsu
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.087	87
1775, 1793, 1799, 1829	0.1	0.087	87
1787, 1817, 1850	0.1	0.092	92
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.097	97
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.096	96
1407, 1431, 1486, 1672	0.1	0.096	96
1166, 1751, 1757	0.1	0.091	91
1190, 1763, 1769, 1870	0.1	0.089	89
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.095	95
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.091	91
1401, 1480, 1648, 1721	0.1	0.093	93
1498, 1606, 1697	0.1	0.104	104
1510, 1571, 1715, 1727,	0.1	0.105	105
1610, 1719, 1755	0.1	0.097	97

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 9. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Carbamate	UCL = 130	Sample Type: Surface Water
Analyte: Oxamyl	UWL = 119	Lab: CDFA
MDL: 0.05 ppb	LWL = 77	Chemist: J. Hsu
	LCL = 66	

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
1413, 1419, 1425, 2353	0.1	0.099	99
1775, 1793, 1799, 1829	0.1	0.088	88
1787, 1817, 1850	0.1	0.099	99
1160, 1781, 1811, 1832, 1838, 1844, 1856, 1862, 1868	0.1	0.082	82
1395, 1492, 1703, 1709, 1739, 1745, 1823	0.1	0.091	91
1407, 1431, 1486, 1672	0.1	0.091	91
1166, 1751, 1757	0.1	0.098	98
1190, 1763, 1769, 1870	0.1	0.100	100
1178, 1564, 1612, 1636, 1642, 1654, 1660, 1678, 1873	0.1	0.090	90
1444, 1450, 1552, 1630, 1666, 1691, 1733	0.1	0.083	83
1401, 1480, 1648, 1721	0.1	0.087	87
1498, 1606, 1697	0.1	0.087	87
1510, 1571, 1715, 1727	0.1	0.094	94
1610, 1719, 1755	0.1	0.087	87

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 1. Continuing quality control data for the Summer 199 1 San Joaquin River study.

Screen: Endosulfan | UCL = 113 | Sample Type: Surface Water
Analyte: Endosulfan I | UWL = 106 | Lab: CDFA
MDL: 0.005 ppb | LWL= 76 | Chemist: Karen Hefner
LCL= 69

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppt)	Results (ppt)	Recovery %
381, 387, 435	12.5	12.0	96
346, 490, 503	10.0	8.5	85
346, 406, 562	10.0	8.5	85
564	10.0	9.6	96
298, 370, 418, 483	10.0	8.8	88
304, 358, 376	10.0	9.8	98
286, 340, 413	10.0	7.0	70
292, 364, 467, 472	10.0	9.7	97
508, 526, 617	10.0	9.0	90
599, 635, 641, 647, 653	10.0	8.6	86
623, 659, 670, 677	10.0	8.8	88
731, 749, 743	10.0	10.4	104
737, 839, 863	10.0	10.4	104
689, 791, 845	10.0	8.8	88
682, 701, 725, 832	10.0	9.8	98
773, 785, 911	10.0	9.9	99
694, 7 12,820	10.0	8.7	87
607, 767, 803	10.0	8.7	87
809, 881, 917, 935	10.0	10.6	106

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 2. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Endosulfan | UCL = 145 | Sample Type: Surface Water
Analyte: Endosulfan II | UWL = 131 | Lab: CDFA
MDL: 0.005 ppb | LWL = 75 | Chemist: Karen Hefner
LCL= 60

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppt)	Results (ppt)	Recovery %
381, 387, 435	12.5	9.9	79
346, 490, 503	10.0	10.9	109
346, 406, 562	10.0	9.1	91
564	10.0	9.6	96
298, 370, 418, 483	10.0	9.2	92
304, 358, 376	10.0	10.3	103
286, 340, 413	10.0	9.7	97
292, 364, 467, 472	10.0	10.2	102
508, 526, 617	10.0	10.2	102
599, 635, 641, 647, 653	10.0	9.2	92
623, 659, 670, 677	10.0	11.1	111
731, 749, 743	10.0	10.0	100
737, 839, 863	10.0	9.4	94
689, 791, 845	10.0	9.1	91
682, 701, 725, 832	10.0	8.9	89
773, 785, 911	10.0	11.3	113
694, 7 12,820	10.0	10.0	100
607, 767, 803	10.0	9.8	98
809, 881, 917, 935	10.0	8.9	89

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 3. Continuing quality control data for the Summer 1991 San Joaquin River study.

Screen: Endosulfan

Analyte: Endosulfan sulfate
MDL: 0.005 ppb

UCL = 147
UWL = 131
LWL= 68
LCL = 5 2

Sample Type: Surface Water
Lab: CDFA
Chemist: Karen Hefner

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppt)	Results (ppt)	Recovery %
381, 387, 435	12.5	13.3	106
346, 490, 503	10.0	11.6	116
346, 406, 562	10.0	9.8	98
564	10.0	8.0	80
298, 370, 418, 483	10.0	9.8	98
304, 358, 376	10.0	10.6	106
286, 340, 413	10.0	10.7	107
292, 364, 467, 472	10.0	12.2	122
508, 526, 617	10.0	12.2	122
599, 635, 641, 647, 653	10.0	9.2	92
623, 659, 670, 677	10.0	12.5	125
731, 749, 743	10.0	10.7	107
737, 839, 863	10.0	10.5	105
689, 791, 845	10.0	11.6	116
682, 701, 725, 832	10.0	8.6	86
773, 785, 911	10.0	11.7	117
694, 7 12,820	10.0	11.8	118
607, 767, 803	10.0	10.1	101
809, 881, 917, 935	10.0	9.4	94

UCL = upper control limit, UWL = upper warning limit, LWL = lowe

Table 1. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Endosulfan	UCL = 109		Sample Type: Surface Water
Analyte: Diazinon	UWL = 104		Lab: CDFA
MDL: 0.05 ppb	LWL= 86		Chemist: K. Hefner
	LCL= 81		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
105, 2354, 1414, 1420, 1426	0.5	0.42	84
1776, 1794, 1800, 1830	0.5	0.42	84
1161, 1845, 1812, 1782, 1833, 1857, 1839, 1863	0.5	0.48	96
1788, 1818, 1851	0.5	0.52	104
1704, 1740, 1746, 1824	0.5	0.50	100
1167, 1752, 1758	0.5	0.45	90
1170, 1191, 1764, 1871	0.5	0.51	102
1179, 1637, 1779, 1874, 1565	0.5	0.49	98
1613, 1655, 1643, 1661, 1679	0.5	0.48	96
1631, 1553, 1445, 1734	0.5	0.46	92
1451, 1667, 1692	0.5	0.53	106
1402, 1481, 1649, 1722	0.5	0.47	94
1499, 1607, 1698	0.5	0.49	98
1511, 1572, 1716, 1728	0.5	0.52	104
1766	0.5	0.39	**78***
1615, 1181	0.5	0.50	100

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

* Matrix spike recovery fell below the lower control limit.

Table 2. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Endosulfan	UCL = 120		Sample Type: Surface Water
Analyte: Diazinon OA	UWL = 115		Lab: CDFA
MDL: 0.05 ppb	LWL= 93		Chemist: K. Hefner
	LCL = 8 8		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
2354, 1414, 1420, 1426	0.5	0.44	88
1776, 1794, 1800, [illegible]	0.5	0.42	**84***
1788, 1818, 1851	0.5	0.44	88
1161, 1845, 1812, 1782, 1833, 1857, 1839, 1863	0.5	0.52	104
1704, 1740, 1746, 1824	0.5	0.55	110
1167, 1752, 1758	0.5	0.45	90
1170, 1191, 1764, 1871	0.5	0.54	108
1179, 1637, 1779, 1874, 1565	0.5	0.53	106
1613, 1655, 1643, 1661, 1679	0.5	0.55	110
1631, 1553, 1445, 1734	0.5	0.52	104
1451, 1667, 1692	0.5	0.55	110
1402, 1481, 1649, 1722	0.5	0.53	106
1499, 1607, 1698	0.5	0.58	116
1511, 1572, 1716, 1728	0.5	0.54	108
1766	0.5	0.44	88
1615, 1181	0.5	0.51	102

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

* Matrix spike recovery fell below the lower control limit.

Table 3. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Endosulfan	UCL = 1 1 3		Sample Type: Surface Water
Analyte: Endosulfan I	UWL = 106		Lab: CDFA
MDL: 0.005 ppb	LWL= 76		Chemist: K. Hefner
	LCL= 69		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
2354, 1414, 1420, 1426	0.5	0.58	116**
1776, 1794, 1800, 1830	0.5	0.47	94
1788, 1818, 1851	0.5	0.46	92
1161, 1845, 1812, 1782, 1833, 1857, 1839, 1863	0.5	0.44	88
1704, 1740, 1746, 1824	0.5	0.41	82
1167, 1752, 1758	0.5	0.45	90
1170, 1191, 1764, 1871	0.5	0.38	76
1179, 1637, 1779, 1874, 1565	0.5	0.41	82
1613, 1655, 1643, 1661, 1679	0.5	0.46	92
1631, 1553, 1445, 1734	0.5	0.49	98
1451, 1667, 1692	0.5	0.48	96
1402, 1481, 1649, 1722	0.5	0.42	84
1499, 1607, 1698	0.5	0.48	96
1511, 1572, 1716, 1728	0.5	0.44	88
1766	0.5	0.45	90
1615, 1181	0.5	0.40	80

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

** Matrix Spike above upper control limit

Table 4. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Endosulfan	UCL = 145		Sample Type: Surface Water
Analyte: Endosulfan II	UWL = 131		Lab: CDFA
MDL: 0.005 ppb	LWL = 75		Chemist: K. Hefner
	LCL= 60		
Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
2354, 1414, 1420, 1426	0.5	0.58	116
1776; 1794, 1800, 1830	0.5	0.55	110
1788, 1818, 1851	0.5	0.47	94
1161, 1845, 1812, 1782, 1833, 1857, 1839, 1863	0.5	0.43	86
1704, 1740, 1746, 1824	0.5	0.44	88
1167, 1752, 1758	0.5	0.47	94
1170, 1191, 1764, 1871	0.5	0.40	80
1179, 1637, 1779, 1874, 1565	0.5	0.49	98
1613, 1655, 1643, 1661, 1679	0.5	0.45	90
1631, 1553, 1445, 1734	0.5	0.47	94
1451, 1667, 1692	0.5	0.45	90
1402, 1481, 1649, 1722	0.5	0.44	88
1499, 1607, 1698	0.5	0.45	90
1511, 1572, 1716, 1728	0.5	0.44	88
1766	0.5	0.40	80
1615, 1181	0.5	0.44	88

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Table 5. Continuing quality control data for the Summer 1992 San Joaquin River study.

Screen: Endosulfan	UCL = 147		Sample Type: Surface Water
Analyte: Endosulfan Sulfate	UWL = 131		Lab: CDFA
MDL: 0.010 ppb	LWL = 68		Chemist: K. Hefner
	LCL= 52		

Sample Analyzed with Each Extraction Set (Sample Number)	Spike Level (ppb)	Results (ppb)	Recovery %
105, 2354, 1414, 1420, 1426	0.5	0.55	110
1776, 1794, 1800, 1830	0.5	0.47	94
1788, 1818, 1851	0.5	0.52	104
1161, 1845, 1812,1782, 1833, 1857, 1839, 1863	0.5	0.44	88
1704, 1740, 1746, 1824	0.5	0.59	118
1167, 1752, 1758	0.5	0.55	110
1170, 1191, 1764, 1871	0.5	0.64	128
1179, 1637,1779, 1874, 1565	0.5	0.59	118
1613, 1655, 1643, 1661, 1679	0.5	0.38	76
1631, 1553,1445, 1734	0.5	0.46	92
1451, 1667, 1692	0.5	0.52	104
1402, 1481, 1649, 1722	0.5	0.47	94
1499, 1607, 1698	0.5	0.52	104
1511, 1572, 1716, 1728	0.5	0.48	96
1766	0.5	0.39	78
1615, 1181	0.5	0.52	104

UCL = upper control limit, UWL = upper warning limit, LWL = lower warning limit, LCL = lower control limit.

Appendix II. Blind spike results.

Table 1. Blind Spike Data for the Summer (1991 and 1992) San Joaquin River Study.

Chemical	Spike Level (ppb)	Amount Found (ppb)	Recovery (%)	Date Analyzed
<u>Organophosphate Screen</u>				
Azinphos methyl	0.15	0.16	107	7/5/91
Azinphos methyl	0.15	0.16	107	7/12/91
Azinphos methyl	0.15	0.16	107	8/5/91
Azinphos methyl	0.10	0.12	120**	8/21/92
Azinphos methyl	0.10	0.10	100	8/27/92
Chlorpyrifos	0.05	0.05	100	7/5/91
Chlorpyrifos	0.05	0.06	120**	8/5/91
Dimethoate	0.10	0.10	100	7/30/92
Dimethoate	0.10	0.10	100	8/21/92
Dimethoate	0.10	0.08	80	8/27/92
Malathion	0.15	0.15	100	7/5/91
Malathion	0.15	0.15	100	8/5/91
<u>Carbamate Screen</u>				
Aldicarb	0.10	0.09	90	8/21/91
Aldicarb sulfoxide	0.10	0.08	80	9/4/91
Methiocarb	0.10	0.10	100	7/10/92
Methiocarb	0.10	0.08	80	7/29/92
Methiocarb	0.10	0.10	100	8/24/92
Methiocarb	0.10	0.09	90	8/31/92
Methomyl	0.15	0.15	100	7/3/91
Methomyl	0.15	0.14	93	7/15/91
Methomyl	0.15	0.15	100	8/12/91
<u>Endosulfan Screen</u>				
Diazinon	0.10	0.08	80*	7/15/92
Diazinon	0.20	0.20	100	8/21/92

* Matrix spike recovery fell below the lower control limit.

** Matrix spike recovery fell above the upper control limit.

Appendix 111. Water quality and discharge measurements made weekly in the San Joaquin River during the 1991 and 1992 summer seasons.

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 199 1 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
07-02-91	7a	26	7.8	8.3	1900	NA[f]	126	119	7.1
	10	27	8.0	8.9	1710	NA	363	129	8.6
	12	28	8.1	14	1750	NA	363	150	9.8
07-09-91	7a	23	8.0	7.9	2060	0.4	86	208	6.7
	10	24	7.9	8.2	1360	0.4	376	152	8.8
	12	24	7.9	9.3	1440	0.4	500	2 2 4	9.7
07-16-91	7a	23	8.6	8.8	2340	0.4	74	119	11
	10	24	8.6	10	1720	0.6	280	182	16
	12	23	8.5	11	1570	0.6	322	198	11
Rinse[g]								<0.3 mg	<4.0
07-23-91	7a	24	8.0	8.4	1960	0.4	154	114	14
	10	25	8.2	9.0	1510	0.3	297	123	11
	12	26	8.2	11	1490	0.3	323	150	13
07-30-91	7a	26	7.8	6.4	1820	0.8	160	190	13
	10	26	8.2	10	1680	0.8	309	153	12
	12	27	8.2	11	1570	0.4	336	209	9.7

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 1991 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
08-02-91	7a	22	8.0	5.6	1750	0.6	154	181	8.0
	10	22	7.8	7.8	1580	0.4	364	151	6.6
	12	22	7.9	9.0	1490	0.4	349	196	5.1
Rinse								<0.3 mg	<4.0
08-06-91	7a	21	7.9	7.2	1520	0.3	185	221	8.5
	10	22	8.0	9.8	1520	0.9	363	148	11
	12	23	8.1	8.7	1370	1	363	181	7.7
08-09-91	7a	23	7.7	5.8	1670	0.6	151	561	7.2
	10	23	7.8	7.9	1560	0.4	302	277	4.8
	12	23	7.8	8.6	1350	0.4	343	518	7.3
08-13-91	7a	23	7.8	6.5	1580	0.6	194	600	5.6
	10	23	7.9	8.4	NA	0.9	367	368	6.4
	12	24	7.9	9.0	NA	0.8	349	477	5.1
08-16-91	7a	23	7.9	7.9	1860	0.3	146	125	8.4
	10	24	7.9	9.4	1580	1	356	128	11
	12	25	7.9	9.2	1590	1	334	274	9.9
Rinse								<0.3 mg	<4.0

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 1991 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
08-20-91	7a	24	7.8	8.6	1750	0.4	171	174	10
	10	23	7.8	8.7	1530	0.3	333	126	6.1
	12	24	8.0	9.0	1350	0.3	360	141	8.9
08-23-91	7a	21	7.9	7.8	2110	0.4	134	86	4.7
	10	21	7.9	8.2	1700	1	338	126	<4
	12	22	8.0	10	1670	0.4	331	185	6.4
08-27-91	7a	21	8.5	9.8	2040	1-2	137	101	8.6
	10	22	8.3	13	1610	0.4	283	103	7.2
	12	22	8.2	12	1640	0.6	309	140	8.9
08-30-91	7a	22	8.0	6.4	2330	0.4	102	62	8.8
	10	22	7.8	8.0	1560	0.6	325	118	9.6
	12	23	8.0	11	1610	0.3	311	135	11
Rinse								<0.3 mg	<4.0
09-03-91	7a	24	7.9	7.4	2120	0.4	108	86	12
	10	24	7.9	9.4	1730	0.6	281	101	11
	12	25	8.1	12	1150	0.3	300	122	13

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 199 1 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
09-06-9 1	7a	23	7.7	8.0	2630	0.6	71	55	7.9
	10	24	8.0	11	1720	0.9	274	84	14
	12	25	8.4	14	1660	0.6	272	142	12
09-10-91	7a	18	8.1	8.4	1780	0.4	111	140	9.0
	10	20	8.1	13	1510	0.6	351	82	14
	12	21	8.4	17	1600	0.3	293	103	13
09-13-91	7a	21	7.8	8.0	1920	0.6	78	77	6.6
	10	22	7.7	9.8	1480	0.9	312	86	7.1
	12	23	7.6	11	1510	0.4	327	100	7.1
Rinse								<0.3 mg	<4.0
07-08-92	7a	23	7.9	8.3	2460	0.4	68	84	14
	10	24	8.3	13	1610	0.4	255	107	16
	12	25	8.5	13	1510	0.4	244	134	15
07-15-92	7a	29	8.7	15	2230	0.4	101	79	12
	10	27	8.6	16	1830	0.4	262	120	19
	12	25	8.4	8.1	1620	0.3	294	222	13

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 199 1 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
07-22-92	7a	29	8.9	18	2650	0.6	91	72	12
	10	26	8.8	16	1390	0.4	247	94	13
	12	23	8.4	11	1400	0.4	274	122	7.6
08-05-92	7a	26	8.3	10	1800	0.4	115	55	10
	10	25	8.4	13	1380	0.4	291	81	9.7
	12	22	8.0	10	1450	0.4	293	110	10
08-12-92	7a	28	7.8	9.9	1880	0.4	91	48	8.2
	10	26	7.7	9.8	1550	0.3	276	73	8.3
	12	25	8.1	7.8	1540	0.6	329	174	9.4
08-19-92	7a	25	8.1	8.2	2090	0.4	66	35	5.7
	10	25	8.2	11	1350	0.4	236	60	7.3
	12	24	8.1	9.0	1450	0.4	337	100	5.2
09-02-92	7a	22	7.7	7.7	2090	0.6	65	43	<4.0
	10	23	7.6	7.8	1420	0.6	269	35	4.4
	12	22	7.6	7.1	1470	0.4	324	75	<4.0
Rinse								<0.3 mg	<4.0

Appendix III. Water quality and discharge measurements made weekly in the San Joaquin River during the 199 1 and 1992 summer seasons.

Date	Site[a]	Water Temp. (C°)	pH	DO[b] (mg/L)	EC[c] (μS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[d] (mg/L)	TOCe mg/L
09-09-92	7a	24	8.0	11	2400	0.6	69	42	5.4
	10	22	7.7	8.9	1510	0.4	189	26	<4.0
	12	21	7.7	8.2	1520	0.4	207	44	<4.0

a. Site numbers. Site locations can be found in Table 1.
b. DO = dissolved oxygen.
c. EC = electrical conductivity, at 25 °C, in microsiemens per centimeter (μS/cm).
d. TSS = total suspended sediment. Method detection limit = 0.3 mg/L.
e. TOC = total organic carbon. Method detection limit = 1 .O mg/L.
f. NA = not available.
g. Rinse sample. Equipment rinse samples were analyzed to determine if cross contamination occurred between samples.

Appendix IV. Water quality and discharge measurements made during the 18-site surveys conducted during the 1992 summer season.

Appendix IV. Water quality and discharge measurements made during the 1 I-site surveys conducted during the 1992 summer season.									
Date	Site	Water Temp. (C°)	pI-I	DO[a] (mg/L)	EC[b] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[c] (mg/L)	TOC[d] (mg/L)
07-27-92	1	28	8.6	11	3660	0.4	1.6	20	6.2
07-27-92	2	26	8.0	8.1	1460	0.6	64	96	7.8
07-28-92	18	25	8.3	8.4	1650	0.4	70	78	6.0
07-27-92	3	25	8.4	12	4310	0.2	8.5	68	4.6
07-27-92	4	No water in Los Banos Creek at time of sampling.							
07-28-92	5	25	7.3	3 . 3	1200	0.4	20	30	11
07-28-92	6	30	8.4	12	537	0.4	37	14	<4.0
07-28-92	7	32	8.7	16	1930	0.3	109	4 3	6.9
07-28-92	Rinse[e]							<0.3mg	<4.0
07-29-92	8	22	8.2	8.2	1070	0.6	13	380	<4.0
07-29-92	9	22	7.1	6.9	671	1	52	44	<4.0
07-29-92	10	26	8.4	17	1420	0.4	275	85	11
07-29-92	11	25	8.0	8.6	1240	0.4	18	100	5.7
07-30-92	12	23	8.8	13	1590	0.6	246	190	16
07-30-92	13	24	8.1	6.4	470	0.2	79	9	<4.0
07-3 l-92	14	21	7.7	6.4	1400	1	36	490	7.8
07-3 l-92	15	23	8.5	10	1350	0.6	243	190	11

Appendix IV. Water quality and discharge measurements made during the **18-site** surveys conducted during the 1992 summer season.

Date	Site	Water Temp. (C°)	pH	DO[a] (mg/L)	EC[b] (µS/cm)	Total Ammonia (mg/L)	Discharge (ft^3/s)	TSS[c] (mg/L)	TOC[d] (mg/L)
07-30-92	16	25	7.3	8.7	103	0.1	260	10	<4.0
07-31-92	17	24	8.8	13	939	0.4	413	98	6.2
	Rinse							CO.3 mg	<4.0
08-24-92	1	24	8.3	4.9	3960	0.4	0.9	20	16
08-24-92	2	21	7.5	6.7	1140	0.6	79	100	7.7
08-25-92	18	21	7.8	7.1	1240	0.4	93	64	<4.0
08-24-92	3	22	8.4	8.2	2410	0.3	45	88	<4.0
08-24-92	4			No water in Los Banos Creek at time of sampling.					
08-25-92	5	20	7.2	5.5	1210	0.8	23	43	4.4
08-25-92	6	24	7.1	9.2	234	0.2	60	12	<4.0
08-25-92	7	26	8.2	11	1450	0.3	189	42	12
08-25-92	Rinse							CO.3 mg	<4.0
08-26-92	8	20	7.6	8.4	1150	0.8	8.3	330	5.8
08-26-92	9	21	7.1	6.2	592	3	39	27	6.4
08-26-92	10	22	7.7	9.4	1240	0.7	315	52	5.9
08-27-92	11	20	7.8	8.4	1440	0.3	12	58	4.8
08-27-92	12	22	7.9	8.6	1390	0.4	337	93	7.7

Appendix IV. Water quality and discharge measurements made during the 18-site surveys conducted during the 1992 summer season.

Date	Site	Water Temp. (C°)	pH	DO[a] (mg/L)	EC[b] (µS/cm)	Total Ammoni (mg/L)	Discharge (ft^3/s)	TSS[c] (mg/L)	TOC[d] (mg/L)
08-26-92	13	24	7.8	9.8	387	0.2	91	10	4.7
08-28-92	14	20	7.8	7.8	1420	1	13	940	12
08-28-92		Rinse						<0.3 mg	<4.0
08-28-92	15	23	7.6	8.0	1140	0.4	261	120	10
08-27-92	16	23	7.6	8.7	107	0.1	295	15	<4.0
08-28-92	17	24	8.0	9.6	763	0.3	507	78	5.9

a. DO = dissolved oxygen.
b. EC = electrical conductivity measured in microsiemens per centimeter at 25 “C.
c. TSS = total suspended sediment.
d. TOC = total organic carbon.
e. Equipment rinse samples were analyzed to determine if cross contamination occurred between sampling sites.

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